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PICK IT UP

. . . and DROP IT IN!

IT'S AS SIMPLE AS THAT TO INSTALL THE VALVE ASSEMBLY IN A BAKER BAKWIK MODEL "B" DRILL PIPE FLOAT

NO TOOLS OR SPECIAL WRENCHES ARE REQUIRED

The Baker Bakwik Model "B" Drill Pipe Float is made with a straight bore body and contains a simple Valve Assembly constructed entirely without threads, which is *dropped into place by hand* and held securely by the tool joint pin above it. When an unrestricted fluid passage is desired, the Valve assembly can be quickly and easily removed from the Float Body.

POSITIVE ACTING BACK-PRESSURE VALVE

At the slightest reversal of pressure, the Valve, with its recessed oil resistant Seal, instantly seats against the Valve Seat, creating a positive, leakproof seal. The two oil resistant Side Seals act against the Float Body to likewise form a positive seal.

The efficiency of the Baker Bakwik Drill Pipe Float has been proved in thousands of wells in oil fields throughout the world and is considered standard equipment where a positive back-pressure valve in the drilling string is desired.

THE BAKER BAKWIK DRILL PIPE FLOAT AFFORDS THESE IMPORTANT ADVANTAGES

1. It prevents plugging the bit.
2. It eliminates the annoyance of pulling wet strings.
3. It relieves weight on the derrick and rig equipment as well as on the lines and draw works.
4. It lengthens the life of wire lines and brake bands.
5. It minimizes — often prevents entirely — serious damage in the event the drilling string should part.
6. It prevents blow-outs through the drill pipe.

ALSO OF IMPORTANCE . . .

is the fact that the Baker Bakwik Drill Pipe Float can easily be placed at any position in the drilling string; that the unit is designed for long life; that the Valve Assembly can be quickly and easily serviced on the rig floor; and that replacement parts can be secured at practically any Supply Store or Baker Warehouse.

VALVE ASSEMBLY QUICK AND EASILY SERVIC

Replacement of the Valve Seal ordinarily the only servicing requ during the normal operation of Baker Bakwik Drill Pipe Float V Assembly . . . and this opera can be quickly accomplished in four easy steps illustrated. Wh is necessary to replace the Seals,* new ones can be inst with equal ease.

Step 1

Step 2

Step 3

Step 4

STRONG, SAFE VAL ASSEMBLY CONSTRUCTI

Bakwik Drill Pipe Float Valve semblies are constructed of a imum number of essential parts designed to give long, satisfac service. The Cage is made of t abrasion-resistant steel, and the restricted opening through it is proximately the same area as fluid passage through the tool jo The Valve is made of special iron cast integral with the stem. Both Valve and Valve Seat ground to a perfect fit. The V Cage is constructed of close gra grey iron, carefully machined accuracy. The Valve Spring is

Showing Bakwik Drill Pipe F (complete with Valve Assem positioned in drilling strin

signed to perform long, effic service. The two Side Seals one Valve Seal are made of oil sistant packing, and afford maxi wear under all operating condit

BAKER OIL TOOLS, I

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Trends

Crude-Oil Production - By States—Page 156

CRUDE-OIL STOCKS 236,748,000 bbl. as of March 11—down 1,015,000. One year ago 236,655,000 bbl.

GASOLINE STOCKS 86,559,000 bbl. as of March 11—up 468,000. One year ago 94,280,000 bbl.

RESIDUAL FUEL-OIL STOCKS 51,362,000 bbl. as of March 11—up 187,000. One year ago 68,455,000.

GAS OIL AND DISTILLATE STOCKS 32,705,000 as of March 11—down 440,000. One year ago 34,427,000.

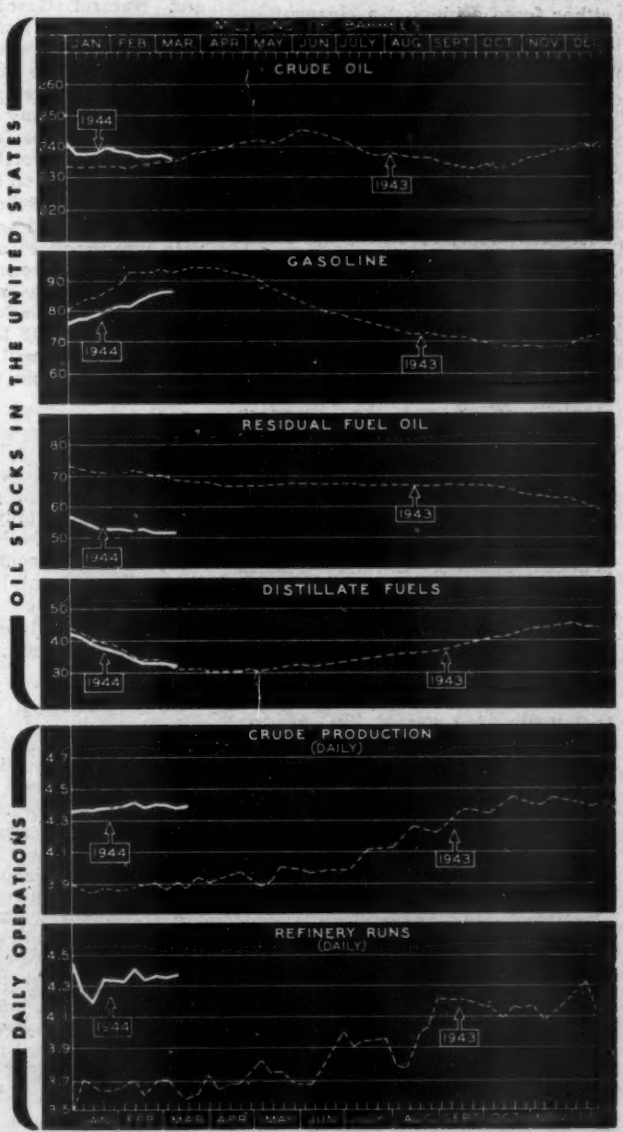
CRUDE-OIL PRODUCTION 4,391,590 bbl. daily average week ended March 18—up 7,910 bbl. Year ago 3,942,900.

REFINERY RUNS 4,387,000 bbl. daily week ended March 11—up 43,000 bbl. One year ago 3,546,000.

JUST how far the difficulties incurred in refining sour crudes will obstruct plans to expand manufacturing and crude-production operations during the second quarter and the remainder of the year is a moot question among operators. The PAW allocations for April provide for a net increase of 79,100 bbl. daily in the production of liquid petroleum, most of which increase is to come from the sour crude fields of West Texas. Arrangements have been made to refine the additional supply. It is known, however, that Petroleum Administration for War had hoped operators would be able to refine more of the sour crudes next month and that plans of that agency provide for further expansion in these operations later in the year.

THE reluctance with which use of sour crudes is accepted is indicated in the fact that District 2 refiners will not take advantage immediately of the additional supplies that could be made available to them from West Texas when the 16-in. line from the Slaughter area to Cushing, Okla., starts operating the first of next month. When this line was projected it was assumed that a number of District 2 refiners would provide an initial outlet of around 40,000 bbl. daily. The line's first deliveries will be for its owner, whose Middle West refineries will take additional deliveries of approximately 14,000 bbl. daily. The other crude delivered will be shipped by tank car to eastern refineries, taking the place of crude now being shipped by tank car from West Texas.

THIS situation reflects the fact that many small and large refiners who have investigated, state that they cannot mix the new crude with their present supplies without running into serious corrosion problems at their plants and without sacrificing yields and quality in their finished products. At the same time it is stated that at least two Middle West refining organizations have been using up to 15 per cent of the sour crudes with satisfactory results. Similar reports have come from eastern refineries, where large quantities of the sour crudes are being utilized, as shown by the fact that shipments of this grade are now in excess of 100,000 bbl. daily in the 24-in. line. Those familiar with this situation explain that there is need for more information on how to refine the sour crudes, including treating, and also assurance as to the support that operators can expect from government agencies in the form of special materials should they encounter corrosion difficulties at their plants.



Opposing Views on Arabian Pipe Line Still Rampant as Neither Side Scores Victory

WASHINGTON. — Major forces of Government and industry continued this week to press their diametrically opposed viewpoints on the Arabian pipe-line proposal of Petroleum Reserves Corp. Blows and counterpunches were unleashed without either force achieving a cleancut superiority.

Individuals close to the inner workings of PRC called it a 9 to 5 gamble that the Arabian line never will be built. On the other hand, Secretary of the Navy Knox, speaking at a Washington press conference March 21, said that the Arabian pipe line should be built at once to insure an adequate supply of oil for the prosecution of the war. He said the joint chiefs of staff have formally approved creation of a military reserve of 1 billion barrels of oil as an aspect of the pipe-line project.

Knox declared that the Arabian project is the birth of a genuine foreign-oil policy and the American people will not let a lot of selfish oil companies divert them from the establishment of an oil policy.

Views of Secretary Knox, of course, are in head-on conflict with practically every oil company and independent operator in the Western Hemisphere and it was a foregone conclusion that his remarks will draw strong replies.

Meanwhile, Petroleum Administrator and Secretary of Interior Ickes refused to release full text of a report made by a special PRC mission which made an on-the-ground appraisal of Middle East petroleum resources. Uncontroverted excerpts from the report leaked out at Washington, however, and confirm previous information that reserves of the Middle East, both proven and remaining to be developed, are fabulous. The report was prepared by a mission consisting of E. DeGolyer, special consultant to PRC; W. E. Wrather, director of the U.S.G.S.; John Murrell, assistant to DeGolyer, and C. S. Snodgrass, codirector of the PAW Foreign Division. "It is the opinion of this mission," said one section of the excerpts, "that, given reasonable time and a very moderate amount of oil-field material, any single one of these four groups can develop and maintain within its own properties sufficient production to supply world requirements from the Middle East area for many years to come. For the next 10 to 15 years at least, the Middle East area is likely to develop and maintain productive capacity of as much as four times its probable market outlet."

Physical Assets

After explaining the ownership of properties in the Middle East petroliferous areas, these points from the mission's report were made concerning the physical assets and the current status of their utilization: "The fields of Iran are currently producing approximately 325,000 bbl. per day and about 50,000 bbl. of residue are being returned to the ground, a net daily withdrawal of some 275,000 bbl. The fields of Iraq are currently producing approximately 90,000 bbl. per day and those of Saudi Arabia and Bahrein a total of 35,000 bbl. per day. The fields of Kuwait and Qatar are shut in. With but little additional drilling, say 40 to 50 wells, these fields are susceptible to considerable increases in production.

"Three significant refineries are located in the area. The largest is that of Anglo-Iranian Oil Co., Ltd., at Abadan which is currently processing some 280,000 bbl. per day of Iranian crude oils. Upon completion, late in 1944, of facilities now authorized, its capacity will increase to 362,000 bbl. per day.

"The Haifa plant of Consolidated Refineries, Ltd., owned jointly and equally by Anglo-Iranian Oil Co., Ltd., and the Royal Dutch-Shell group, now processes about 60,000 bbl. per day of Iraq crude. Extensions to this plant now scheduled for completion in July 1944, will increase its crude charging capacity to 80,000 bbl. per day.

"The third refinery located on Bahrein Island is owned by Bahrein Petroleum Co., Ltd. Construction work now in progress will increase its present daily crude capacity of 33,500 bbl. per day to 45,000 bbl. in July 1944, and to 58,000 bbl. in December 1944.

"Total daily crude capacity of these refineries when extended will be some 500,000 bbl. per day or about 11 per cent of United States refining capacity. Of this 500,000 bbl., only 58,000, or about 11.5 per cent, is American and is owned through a Canadian corporation.

Reserves Difficult to Appraise

"In discussing reserves of this area it is extremely difficult to find a common denominator by which to express them. Our preliminary estimate of reserves actually proved is approximately 5 to 6 billion barrels in Iran, 4 billion barrels each in Iraq and Kuwait, 2 billion barrels in Saudi Arabia and Bahrein, and less than 500,000 bbl. in Qatar. If one considers reserves as proved by developed fields and indicated by fields discovered but not yet fully explored, the proved and indicated reserves in Kuwait appear to be approximately 9 billion barrels, those in Iran 6 to 7 billion barrels, Iraq 5 billion barrels, Saudi Arabia 4 to 5 billion barrels and Qatar 1 billion barrels.

"Obviously any attempt to appraise the prospective areas of this region must be highly speculative. In our opinion, in any attempted rating of undrilled prospect values, Iran and Saudi Arabia must vie for first place. Iraq ranks a close third, with Qatar a somewhat distant fourth and Kuwait a definitely distant fifth. Too little is known of the values of other areas to justify an attempt to rate them.

"When one considers the great oil discoveries which have resulted from the meager exploration thus far accomplished in the Middle East, the substantial number of known prospects not yet drilled and the great

(Continued on Page 63)

POE AND KLINE RESIGN FROM PRC; DeGOLYER ACCEPTS BRAZILIAN POST

E. Holley Poe, director of PRC and formerly director of the Natural Gas and Natural Gasoline Division of PAW, resigned last week and announced that he would return to private industry. He expected to remain in Washington temporarily, possibly until his testimony is heard by the Senate committee appointed to investigate the petroleum situation with special emphasis on foreign aspects.

Mortimer Kline, counsel for PRC, also resigned and will return to private law practice in California.

E. DeGolyer, special consultant to PRC, temporarily relieved of duty because of completion of the Middle East survey, will leave shortly for Brazil where he will advise with government petroleum authorities.

Rising Military Demand Lowers Gasoline Supply Available to Car Owners

by Charles J. Deegan

DESPITE continued suppression of specific figures, scraps of evidence point unmistakably to rising demand in military consumption. Gasoline allocations to other claimant agencies during the second quarter indicate a difference of approximately 650,000 bbl. daily between civilian quotas and current production. Theoretically this difference represents direct military requirements and lend-lease shipments, subject to fluctuations in storage and production. This is one answer to questions of what is happening to domestic gasoline and why was it necessary to make another reduction in the basic rations to civilian motorists in the Middle West, Southwest and West Coast.

Gasoline has gone to war on a scale that very few oil men realize. Military requirements are said to be 600,000 bbl. per day but investigation shows that direct military takings are only a part of the war requirements. The indirect requirements of war cannot be measured accurately, but available data indicate that they may account for almost as much as the direct military demands. A rough, but reasonable estimate is that one-third of the gasoline supply goes directly to the military; one-third to civilian activities directly connected with war work, one-third to civilians whose work is essential, but which is not related directly to war activities.

Owing to the wartime blackout on so many statistics exact comparisons are impossible to obtain but from prewar figures, plus those released by the Government during the war, it is possible to get a fair picture of the current gasoline situation. In Table 1 are figures showing the total demand for automotive gasoline plus aviation fuel in the prewar normal years of 1938 and 1939, plus the figures released by the Government recently about the current situation. Because current demand exceeds supply, the total-demand figure for 1943 is actually the total supply. These total-demand figures are then broken down into classes of users, and a final column added to show the estimated national income for purposes of comparison and interpretation.

These figures show that the 1,800,000 bbl. per day of total supply in 1943 represented roughly an increase of 300,000 bbl. daily over prewar normal. Since military takings are 600,000 bbl. per day, one-half of the direct military requirements have been supplied by increased production. But, industrial and off-highway farm uses have increased, about one-fourth or roundly 50,000 bbl. per day; while truck and bus use has increased about one-third, or roughly 120,000 bbl. per day. The only decrease is in passenger-car consumption, which has been cut almost in half.

These figures reveal an entirely different picture from any that has previously been described. The passenger-car drivers have had to take not only the brunt of squeezing out one-half or 300,000 bbl. per day, of military takings, but an extra 170,000 bbl. per day of increased use required to keep trucks, buses, industrial and farm machinery matching the pace of the war needs.

Even these data fail to tell the whole story. Many civilian passenger cars are being used for direct war work in such a manner that they consume more gasoline per car than in normal times. Literally millions of workers of shipyards, airplane plants, munitions plants, etc., must drive daily round trips of 10, 20 or even 40 miles. There are not enough housing accommodations any closer to the job and public transportation facilities

TABLE 1—DOMESTIC DEMAND FOR MOTOR AND AVIATION GASOLINE

	Thousands of bbl. per day			Thousands		
Year—	Total demand	Military demand	Industry and farm use‡	Trucks and buses	Passenger cars	National income
1943*	1,800	600	200	450	550	$140,000,000,000
1939†	1,530	5	167	345	1,010	70,000,900,000
1938†	1,440	5	158	321	954	64,000,000,000

*Gasoline data from OWI. †Gasoline data from A.P.I. facts and figures. ‡Off-highway farm use.

Acme Photo

Chester Bowles, director of the Office of Price Administration, examining illegal gasoline coupons which account for up to 50 per cent of the supplementary gallonage in the more highly contaminated areas

simply can't handle the load. Therefore the entire burden of reducing gasoline consumption falls on part of the passenger-car drivers, not on all of them. This explains why a mere 18,000 bbl. per day of gasoline is saved when the A-coupon values of all the motorists in 31 states are reduced 33⅓ per cent.

The average motorist then wants to know just what justification is there for this increase in gasoline allocations to industry, off-highway farm purposes, and to trucks and buses. What has been done to see that they get no more than they actually need? Why do they require more gasoline now than they did before the war? are other questions.

These questions cannot be answered categorically, but the national income figures in Table 1 gives a yardstick by which can be measured the reasonableness of the answers of government officials. Officials say that they have done a great many things to reduce gasoline consumption by non-passenger-car users, but that the tremendous war production makes it impossible to hold total demand for these purposes down to the prewar level.

Table 1 shows that the consumption of gasoline for industrial and off-highway farm use plus that consumed by trucks and buses has increased from about 500,000 bbl. per day in 1938-39 to 650,000 bbl. per day in late 1943, an over-all increase of about 30 per cent. The production of goods, measured by national income, increased 100 per cent in that same period. Ordinarily gasoline consumption for these purposes would probably have increased about the same amount as production but it has increased only 150,000 bbl. per day, or 30 per cent. It is not too unreasonable for the government officials to claim that by rationing, they have saved 350,000 bbl. per day from all other uses except passenger cars.

Farmers and Truckers Given Increases

WASHINGTON.—Automotive gasoline allocations of 1,257,000 bbl. a day for civilian consumption during the second quarter of the year, an increase of 140,000 bbl. daily over the first quarter, were certified last week by the Petroleum Administration for War. The increase covers seasonal requirements to farmers, truckers and construction companies, but includes no extra gasoline for civilian driving.

At the same time, the Office of Price Administration reduced A gasoline rations west of the Alleghenies from 3 to 2 gal. a week, and tightened B rations on the Pacific Coast from 460 to 400 miles per month. The reductions became effective March 22.

In connection with the ration cuts, PAW's deputy administrator, Ralph K. Davies, said: "The responsibility of PAW is for petroleum supply. The PAW does not set the value of ration coupons. That is the function of OPA. The PAW is on record as saying that it believes that petroleum products should be equally distributed throughout the nation, with proper allowance for geographical differences in requirements. How this equitable distribution shall be achieved is a problem of the Office of Defense Transportation and the rationing agency. PAW is doing all that is physically possible to produce a maximum of supply."

Total allotment certifications, transmitted by PAW to OPA for the April-May-June period meet in full the gasoline requirements requested by the Office of Defense Transportation, the War Food Administration, and the Office of Civilian Requirements.

Allocations include:

DISTRIBUTION OF QUOTAS AMONG CLAIMANT AGENCIES
(Barrels daily)

	ODT	WFA	OCR
District 1	345,000	15,000	27,000
District 2	386,000	119,000	91,000
District 3	128,000	21,000	5,000
District 4	28,000	8,000	2,000
District 5	124,000	9,000	11,000
Total	1,009,000	172,000	76,000

Note: ODT=Office of Defense Transportation; WFA=War Food Administration; OCR=Office of Civilian Requirements.

1944 SECOND-QUARTER ALLOCATIONS

District	Certified quota (bbl. daily)	Increase from first quarter
1. East Coast	387,000	15,000
2. Middle West	596,000	103,000
3. Southwest	152,000	6,000
4. Rockies	33,000	6,000
5. West Coast	144,000	10,000
Total	1,257,000	140,000

ODT SECOND-QUARTER QUOTAS FOR AUTOMOTIVE EQUIPMENT
(Figures in barrels daily)

	Passenger cars	Trucks	Public buses, taxis	Water transp.	Railroads
District 1	171,485	128,885	37,364	6,718	275
District 2	230,674	131,478	21,728	1,847	275
District 3	62,882	53,532	7,087	2,239	250
District 4	14,744	11,589	1,463	none	125
District 5	80,559	34,850	4,931	3,410	250
Total	560,354	360,412	72,772	14,212	1,175

Black-Market Coupons Constitute Gargantuan Underworld Racket

WASHINGTON.—A gargantuan underworld racket in black-market gasoline coupons which drains 2,500,000 gal. (nearly 60,000 bbl.) of gasoline a day from legitimate users is currently under attack by the Office of Price Administration, the petroleum industry, and, OPA hopes, the general public.

Traffic in counterfeit ration stamps has reached a point where 15 per cent of all the C coupons, about 8 per cent of the B's and a smaller number of A's are found to be counterfeit. The racket, according to OPA administrator Chester Bowles, is operated by the same highly organized underworld which once operated liquor, narcotics, white slave and counterfeit-money rings.

In the New York region, OPA estimates that 25 to 30 per cent of all coupons are counterfeit, with the average in Baltimore running 45 per cent. The Cleveland region reports 15 to 25 per cent counterfeit, with Richmond, Va., and Raleigh, N. C., running as high as 50 per cent. The Chicago region estimates its counterfeit coupons at 15 per cent of all coupons in use, with a high of 50 per cent in Milwaukee. The San Francisco Bay area also estimates 15 per cent counterfeit.

A new organization of OPA special agents is working on the second problem, and in 2 months 245 peddlers and wholesalers of counterfeit coupons have been arrested.

New steps are also being taken to stop the leaks in stolen coupons as well. R coupons are now invalid at city service stations, thus restricting them to their intended off-highway use. Numbered strip coupons are being substituted for the old TT truck coupons, riddled with counterfeits. OPA is also setting up central issuance centers for ration coupons in large cities, thus keeping coupons in a central spot, policed by armed guards.

Atlantic Pipe Line Co. Sets New Safety Record

DALLAS. — J. H. Wood, Jr., vice president and general manager of Atlantic Pipe Line Co., announced that the world's record of all pipeline companies had been broken March 16 by Atlantic for man hours worked without a disabling injury.

The new record, which is more than 1,280,000 hours and still continuing, started on September 14, 1942. Since that time no employe of the Atlantic Pipe Line Co. has lost time because of industrial injury.

The company has had an outstanding record in connection with accident prevention work. The National Safety Council's records indicate that for the years 1940-42, Atlantic had the best record of all companies in the U. S.

THIS WEEK

PRODUCTION—Highest production quota in history, 4,725,000 bbl. daily, assigned industry in April. . . . Texas raised 78,000, Louisiana upped 6,000. . . . California quota reduced, reflecting inability to produce allocation. . . . Interior districts virtually unchanged. . . . ¶Anadarko basin wildcat, west of Nemaha Ridge, showing for commercial production. . . .

DRILLING—Completions spurted last week, up nearly 34 per cent. . . . Rise about equally divided between oil wells and dry holes, gassers decline. . . . ¶Formal upward revision of PAW's 1944 drilling program expected in few weeks. . . . ¶Technicalities delay revised order liberalizing spacing regulations in Illinois. . . . ¶Deep locations in Winkler County, West Texas, Ellenburger fields and West Edmond, Oklahoma, delayed by lack of adequate rigs. . . .

FOREIGN—Fight over Arabian line continues hottest issue in industry. . . . Portions of DeGolyer report leak out at Washington. . . . Ickes undecided on releasing full report. . . . ¶Four Middle East countries, Iran, Iraq, Kuwait, Saudi Arabia, have nearly 17 billion proven reserves. . . . Speculative reserves, based on discovered but undeveloped fields added to proven areas, total 26-27 billion. . . . ¶Kuwait, with speculative reserves of 9 billion, ranks last in prospective new discoveries, indicating its fields are fairly well known. . . . ¶Report shows refinery construction at three significant plants in Middle East will have capacity of 500,000 bbl. daily by end of year. . . . ¶Speculators wager 9 to 5 against Arabian line construction. . . . ¶Secretary of Navy Knox advocates immediate start of line, says Joint Chiefs of Staff want 1 billion reserve. . . . Blames opposition on selfish oil companies, asserts Arabian project is birth of foreign-oil policy, declares public will not tolerate longer delay. . . .

TRANSPORTATION—Shipments of West Texas sour oil through Stanolind Pipe Line Co.'s 16-in. line from Slaughter to the Drumright-Cushing, Okla., area to start next week. . . . ¶Application filed for steel to build West Texas-California line. . . .

PRICES—OPA completes subsidy plan for stripper-well production. . . . Proposal in hands of Fred M. Vinson, director of stabilization, who must decide propriety, effective date, delegate administrative duties. . . . ¶Price increases, ranging from 5.3 to 12 cents per barrel, granted in three old Louisiana and Arkansas fields. . . .

RUBBER— Progress Report 5 emphasizes concentration of work on butyl plants, plans to use this synthetic in most tire tubes. . . . ¶Civilian tire outlook unimproved, public cautioned to reduce speeds, watch inflation, recap before carcass is ruined, otherwise—no driving later this year. . . .

Tank cars standing on an English siding awaiting the day when they will follow invasion armies with vital petroleum products. This is one of the numerous war demands making it impossible to handle all available domestic petroleum supplies via overland routes

Acme Photo

Production-Subsidy Plan Completed and Sent to Stabilization Director Vinson

WASHINGTON.—The Office of Price Administration has completed its plan to subsidize production from stripper wells and has submitted the plan to Director Fred M. Vinson of the Office of Economic Stabilization.

Details of the plan were not made public but officials said it was the same which was presented to the meeting of the Independent Petroleum Association of America and the National Stripper Well Association in St. Louis March 10.

The plan calls for permitting refiners and crude purchasers to increase by 35 cents per barrel the price paid to producers in fields designated as strippers, and the purchasers will be reimbursed by the Government while maintaining present product prices. Thus producers will have no direct contact with the Government and will not submit records or reports.

OPA officials believe they have evolved a definition of stripper-well fields which will cover about 80 per cent of the wells of the country producing less than 10 bbl. per day. The remaining strippers are marginal or special-problem wells, such as those of unusual depth or large water yield, and these will be given special and individual study before they are made eligible for the subsidy. OPA estimates cost of the program at between $40,000,000 and $60,000,000 yearly.

The OES probably will give the plan considerable study and may refer it to the Petroleum Administration for War for comment, but OPA officials said they hoped for an early decision to put the plan into effect.

Legality of the subsidy plan was defended by OPA Administrator Chester Bowles in replying to an inquiry from Russell B. Brown, general counsel of the I.P.A.A. In this letter Bowles said:

"I am very happy to answer the five questions you have put to me, as far as I can do so at this time. I have delayed answering your letter in the hopes that I could freely discuss our recommendations to Judge Vinson on aid to stripper wells. Since our recommendation will probably not be transmitted for another 2 weeks as a result of a request of a group of which you were a member, and since the press has misinterpreted this delay, I shall give such answers to your questions as are now possible.

"1. We believe that the Government possesses the legal authority to establish an incentive plan for the petroleum industry to stimulate exploratory drilling and to help keep stripper wells in operation.

"2. We believe that funds can be made available for such an incentive plan by the Government without a special appropriation by Congress.

"3. We estimate that if petroleum prices are increased 35 cents per barrel, the direct cost to the U. S. Government on its oil purchases will be $185,000,000 and that in addition it will cost the public $375,000,000, making a total cost of $560,000,000. These figures are based upon an estimated production this year of 1,600,000,000 bbl. If the price increase were confined to production from new discoveries and stripper wells, the total cost to the Government would not exceed $115,000,000. The net difference which would be saved even by this approach you will note is $70,000,000 to the Government itself and $375,000,000 to the public.

"4. We are preparing a selective inducement plan for stripper wells at the request of Judge Vinson, director of the Office of Economic Stabilization. While we have already discussed the plan we have in mind with you as a representative of stripper-well producers to determine its feasibility before submission to Judge Vinson we do not believe it would be appropriate for us to discuss the plan in detail in a letter until Judge Vinson and the petroleum administrator have had an opportunity to review it. As you know, the plan is a relatively simple one, which should be easy and inexpensive to administer. In our opinion, it is for Judge Vinson to decide who should administer the plan. It probably would be more appropriate to have it managed by the Petroleum Administration for War or the Reconstruction Finance Corp. However, if asked to do so, we would not refuse the responsibility.

"5. We believe that if the plan we are considering meets with approval and orders are given to put it into operation, the administrative details can be set up in a relatively short period. We have already gathered much of the statistical information necessary to put the plan into effect."

Technical Discussions Give Way To Problems of Manpower

DALLAS.—Scientists here this week for the annual meeting of the American Association of Petroleum Geologists, the Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists cast aside many aspects of technical discussions and gave top consideration to manpower.

Secondary interest was divided among: (1) Possibilities of new petroliferous regions in Mississippi to Florida; (2) possibilities of new producing regions in older oil states such as western Oklahoma, Kansas and areas off the central uplift; (3) new regional studies of West Texas and New Mexico with special interest in deep Ellenburger areas; (4) probable extent and importance of the lower Gulf Coast and adjacent South Texas areas; (5) the over-all concern about reworking old areas intensively which sooner or later means more expensive work for diminishing results.

Scientists concurred that the Rocky Mountains and West Texas are the only areas where exploration prospects are relatively encouraging and both areas are limited by transportation outlets.

Geophysicists are harder hit and more worried about manpower than geologists. Geophysics, a commercial profession, in the oil industry is less than 20 years old and surveys indicate only 20 per cent of the total manpower is over 37 years old, 25 per cent is under 26 years of age, 55 per cent is between 26 and 37 years old.

Manpower studies indicate about one key man per party falls in 18

(Continued on page 82)

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Gasoline Rationing

LAST August, just before a reduction in the A gasoline coupons from 4 to 3 gal. outside the eastern states became effective, this page pointed out that "lowering coupon values is no remedy. It will force more A card holders to request extra gallonage while B, C and T operators will seek more coupons. In the end A card owners . . . will have all their gasoline taken from them."

Wednesday of this week another step in the carrying out of this prediction became effective when the value of the A coupons was reduced from 3 to 2 gal. in those sections of the country where it was not already in force. Nothing has been done in the way of adequate remedies for conditions which brought about the first general downward adjustments in the A coupons, and if present policies are continued additional reductions are inevitable. Furthermore, unless action is taken quickly the oil business is going to be an innocent party to the most unsavory scandal of the emergency.

The present output of gasoline in this country is about 1,800,000 bbl. daily, an all-time record. Two-thirds of this total goes to the military, agriculture and to commercial vehicles. This leaves approximately 600,000 bbl. daily for 23,500,000 family cars.

One-half of this 600,000 bbl. daily, or only 17 per cent of the total national supply, would furnish all family car owners with a base ration of 4 gal. per week. The remaining 300,000 bbl. would be available to those who, because of occupations or for equally sound reasons, are entitled to supplementary supplies in addition to the A ration.

The basic trouble lies in the division of responsibility in regard to supply and demand. The oil industry and its war agency are held accountable for constantly increasing supplies, while the military and the Office of Price Administration determine the demands and how they are allocated. Oil operators are maintaining the deposits at the bank while someone else draws the checks.

The OPA's handling of gasoline rationing has been one of makeshifts often dominated by political expediencies until there is nothing left but patchwork. It now concedes that counterfeit coupons and other phases of a black market account for 2½ million gallons daily, three times the quantity which will be saved in the new rationing program. Local rationing officials realize that the issuing of supplementary rations is rapidly getting completely out of hand with every conceivable type of abuse. There also is need for a careful check on the tremendous quantities of gasoline assigned to the non-highway uses of agriculture. A similar analysis of the military situation would be of value.

The contention of the Washington administration that there is a large percentage of family cars which can get along with little or no gasoline is entirely fallacious. Outside Washington there are few nonessential civilian activities. Those who are continuing at their prewar work are the backbone of the war economy. The already overcrowded public transportation facilities offer no solution for the needs of these millions of civilians who must depend on their cars to assist them in doing their part.

The remedy, even at this late date, is to turn over to Petroleum Administration for War the governmental direction of civilian distribution. That agency, in cooperation with refiners and distributors who know more about the problems involved than anyone else, can make effective a simplified and workable rationing program and end the danger of a major crisis in our home economy.

Synthetic-Rubber Plan to Suffer Unless Engineers Are Spared by Military

by Henry D. Ralph

WASHINGTON. — Continued draft deferment of young chemists and other key technologists and of able-bodied men for heavy work in tire fabrication is now the biggest need facing the synthetic-rubber program, Rubber Director Bradley Dewey declared in releasing his fifth progress report March 18.

A study is being made of the number of key men of draft age which are essential to the success of the rubber program.

Most of the synthetic rubber plants are now in operation, though not all at capacity, and the current production rate is greater than consumption in any year prior to 1941, the report disclosed. In spite of this, however, the production of civilian tires this year will be far below the demand.

The substitution of synthetic for natural rubber in tires depends chiefly on the amount of rayon cord available for heavy-duty tires, and additional rayon facilities will not be completed for some time.

Projected Synthetic Production

A total of 90,000 tons of natural crude is expected to be imported during 1944 from all sources of supply, but the inventory will drop to 55,000 tons by the end of the year. This year's production of synthetic is scheduled at 869,000 tons, and stocks of both crude and synthetic will remain at the low working level of 170,000 tons or less throughout the year.

Major construction work on the synthetic rubber and feed-stock plants is virtually completed except for five, though many changes and improvements must be made in many plants before they can operate at capacity. The unfinished plants are the butyl rubber plant at Baytown which is scheduled for completion in June, and four plants for making butadiene from petroleum: the Sinclair plant in Houston which will be turned over by the contractor within a week or two, the Philadelphia plant which should be finished in April, the second half of the Port Neches plant which is due for completion in May, and the Lake Charles plant scheduled for completion in June.

The butyl program is now being rushed. Butyl rubber will be used for most of the inner tubes produced as soon as a supply is available. Dewey explained that the butyl program lagged for some time while various production kinks were removed, but now that technical difficulties have been eliminated the butyl capacity will be expanded rapidly.

Alcohol plants, now running 160 per cent of rated capacity, will produce the bulk of butadiene for buna-S until the latter part of this year. Dewey admitted that butylene for making butadiene is also in demand for aviation gasoline but said the Petroleum Administration for War has assured him the rubber program will receive its basic requirements.

The chief technical problem facing the rubber program is the tendency of buna-S to deteriorate at high temperatures developed in heavy-duty tires, and Dewey stated that research work now in progress promises to develop either an improved buna-S or a new type of synthetic rubber which will be at least as good as natural rubber. He declined to indicate the nature of this research or the results obtained to date, saying that months or years of study are still required and predictions of possible accomplishments might lead to unjustified expectations of early production of a better synthetic rubber.

Other highlights of the progress report follow:

"Other new war programs, rated as more vital and immediate, have caused delay in the final completion of some of the large butadiene-from-petroleum plants. Consequently, production will not be at full capacity until the second half of 1944."

"The Army has operated three major proving grounds using several hundred vehicles and at this time approximately 73 per cent of the ultimate conversions projected for military tires have been made.

"All small sizes, including passenger types, jeep tires and industrial pneumatics are now made with essentially 100 per cent buna-S synthetic rubber and cotton. One hundred per cent buna-S and cotton are also used in all tractor tires.

"Medium sizes, principally 7.50-20 and 9.00-16 mud-snow type, are being made with 10 per cent crude rubber, 90 per cent buna-S and cotton cord. The Army's preference is for rayon cord for these tires, but until sufficient rayon is available, tires made with cotton with two additional cotton cord cap plies are being accepted.

"Thirty per cent crude rubber and 70 per cent buna-S are being used in medium military highway tires and several sizes of combat tires which are made with thick inner linings of soft rubber to permit their running flat after puncture by bullets. All large military tires 11.00 and up are made of crude rubber. Most of these sizes can be converted to 50-70 per cent buna-S as soon as rayon is available."

Car Tires for Civilians

"Passenger tires cannot be produced in the quantities desired during the immediate future, for tire factories must for the present use their supply of buna-S and tire cord on production of tires for military vehicles, airplanes, and essential trucks and buses. Until July, only slightly more than 1,000,000 passenger-car tires will be built each month and some of these will be held as a reserve to protect against unexpected new emergency demands which might later interfere with production.

"In the last progress report it was felt that the result of normal attrition would call for the building in 1944 of 30,000,000 new passenger-car tires. Based on present conditions it is now believed that, with the public's cooperation, 22,000,000 passenger tires will be sufficient for essential driving."

First Posting for Willamar Made by Pan American

HOUSTON, Tex. — Pan American Production Co. has announced that it will pay 98 cents a barrel for crude from the Willamar field, in Willacy County, Texas. This is a new posting, effective as of March 1 at 7 a.m.

Views in Conflict on Arabian Pipe Line

(Continued from Page 56)

areas still practically unexplored, the conclusion is inescapable that reserves of great magnitude remain to be discovered. The proved and indicated reserves of this area are comparable with those of the United States, yet all of the Middle East reserves have been discovered by the drilling of less than a total of 150 wildcat wells. In the United States we drill more than 20 times this number of wildcat wells each year."

Moore Wins Audience Victory in Debate on Arabian Pipe Line

NEW YORK.—If audience reaction may be used as a basis for judgment, Sen. E. H. Moore (R-Okla.) won a clean-cut decision over Petroleum Administrator Harold L. Ickes in their no-decision, verbal battle on the merits of government participation in the development of foreign oil resources at America's Town Hall Meeting of the Air last Thursday night. The senator, who admitted that he came equipped "with both knucks and boxing gloves," received more frequent and more sustained applause from an audience that indicated a pronounced sympathy for his opposition to government participation.

The rebuttal proved one of the liveliest in the history of the program.

Moore asked Ickes why steel has not been granted for the construction of a 600-mile line from Iraq to the eastern Mediterranean which could move more oil than the proposed trans-Arabian line and be paid for by the owners. Ickes replied that he was interested in marketing American and not British oil. Moore regarded the answer as incompatible with the administrator's avowed intention of protecting American reserves.

The discussion reached another peak when Moore asked Ickes, in light of his statements that United States reserves are dwindling, just how much they declined in 1943. When Ickes attempted to compare two periods, Moore repeatedly interrupted, insisting on a direct answer, stating himself that our total resources had dropped only 18,000,000 bbl., less than 4½ days' supply. However, Ickes scored his most telling point in the exchange when he stated that 10 years ago our reserves were equivalent to 20 years' supply against 14 years' supply today. It brought him his best round of applause of the evening.

The debate finished with a series of questions from the audience. Among the more pertinent replies were the following:

Ickes: The line will not be constructed if it can not be undertaken "without impinging on our war effort to get steel."

Moore: (After Ickes said the oil interests would benefit most). The companies have access to Mother Ocean by which they can transport the oil by tanker at less cost than by pipe line.

Ickes: The project should go on if war ceases because "we should be prepared for war any time."

Moore: More oil can be moved from the Permian basin to California (for the Pacific war) by way of a 900-mile pipe line in our own country than Mr. Ickes says can be sent from Saudi Arabia.

Ickes: No contracts have been signed and economics will determine whether or not they are. A big market exists in the Mediterranean and the pipe line is the cheapest way to supply it.

Moore: Our Army and Navy would not be required to protect private interests in foreign lands since economic forces which we could invoke would be sufficent if we followed the foreign policies of Colby and Hughes.

Preliminary Statements

Preliminary to the give-and-take set-to the speakers presented their divergent positions.

Ickes argued that new oil discovered has been less than the quantity consumed. The oil industry has insisted upon higher prices for crude as an incentive to new drilling. One way to improve oil's outlook is to utilize foreign resources. Concerning the argument that the proposed pipe line would put the Government into the oil business, the three companies involved apparently do not believe that or they would have nothing to do with the enterprise. The Government, Ickes said, will own no stock, will have no members on boards of directors, will dictate no policy.

Instead of preventing wars, Moore contended, the pipe line would be a provocative to war. It would be impossible, he declared, for the Government to develop foreign oil reserves or maintain a transportation system without maintaining also a military force to protect proprietary rights. The Arabian project would not create a single barrel of oil and would not make any new oil available to the United States or any other market. The line would connect seaports now served by tanker transportation at a cost less than that involved in the proposed pipe-line movement.

Oil Production Quota Reaches All-Time High

WASHINGTON.—An all-time high in the daily production rate of petroleum liquids has been certified to the oil-producing states for April 1944 by Petroleum Administration for War. The new figure is 4,725,000 bbl., a net daily increase of 79,100 bbl. over the amended rate certified for March. The previous top was 4,707,150 bbl., certified for January 1944.

The production rates certified to Districts 1 and 2 of PAW are virtually unchanged, as many of the unrestricted fields in these regions now have settled production.

In the Rocky Mountain area, District 4, the rate is reduced slightly to maintain a balance between production and available transportation. For California, District 5, a slightly reduced rate is certified to conform with declining productive capacity. Production rates for the southwestern states, District 3, are increased by 83,000 bbl. per day, with Texas receiving 78,000 bbl. of it.

Following are the daily rates of production certified for each state during April:

	Certified total petroleum liquids	Estimated natural gasoline and condensate
District 1:		
New York	13,400	.....
Pennsylvania	42,300	1,300
West Virginia	15,600	6,800
Total	71,300	8,100
District 2:		
Illinois	228,000	13,000
Indiana	13,600	.....
Kansas	290,800	5,800
Kentucky	25,700	2,700
Michigan	53,300	300
Nebraska	1,000	.....
Ohio	9,700	500
Oklahoma	356,000	28,000
Total	978,100	50,300
District 3:		
Arkansas	81,700	5,000
Louisiana	381,700	34,000
Mississippi	45,000	.....
New Mexico	116,600	4,900
Texas	2,043,000	127,000
Total	2,668,000	170,900
District 4:		
Colorado	7,000	.....
Montana	24,300	300
Wyoming	99,900	6,900
Total	131,200	7,200
District 5:		
California	876,400	47,800
Total U. S.	4,725,000	283,500

Jones & Laughlin Supply Co. Succeeds Frick-Reid Firm

FORMATION of the Jones & Laughlin Supply Co. to succeed Frick-Reid Supply Corp., a wholly owned Jones & Laughlin Steel Corp. subsidiary, was announced last week by H. E. Lewis, president of the steel corporation. The change in name was made to more clearly identify the supply company's activities and its relationship to the corporation. The principal office of the new company will remain at Tulsa.

The new company is exclusive distributor of Jones & Laughlin oil country tubular products east of the Rocky Mountains. For 40 years Frick-Reid has served all branches of the oil and gas industries and in recent years its activities have been enlarged to include process engineering and construction of refineries, gasoline plants, cycling, repressuring and other types of plants.

J. L. Shakely, who has been with Frick-Reid more than 30 years, and president since 1938, has been elected president of the new company. Other officers, including Robert McCoy, Jr., executive vice president; H. H. Wilson, vice president, and P. R. Warner, treasurer, also have been elected to serve in identical capacities with the new company.

Reappointments in the new company organization include R. P. Mase, chief engineer; N. C. Turner, assistant chief engineer; S. A. Whitehurst, manager of sales; V. C. Canter, general superintendent; L. G. Sutter, assistant general superintendent, all of the engineering division and Rainey Elliott, sales manager of general supplies.

R. J. Woods will be manager of tube sales of the supply company in the Mid-Continent area, with headquarters in Tulsa. Woods was formerly district sales manager for Jones & Laughlin Steel Corp. in Tulsa and has been succeeded in that capacity by J. H. Tice.

Henry J. McAdams, formerly with the steel corporation in New York City, has been appointed manager of Jones & Laughlin Supply Co., New York office.

H. E. Wagner, district sales manager in the eastern oil and gas fields for the supply company, is being transferred from headquarters at Bradford, Pa., to the supply company's offices at 311 Ross Street, Pittsburgh, Pa. J. K. Lytle continues in the capacity of assistant to Wagner.

The Houston office will continue under the direct supervision of H. H. Wilson, vice president, with T. L. (Dick) Lewis, who recently joined the organization, as district manager of tube sales. They will be assisted by C. B. Moore, city sales manager; G. S. Emerson, salesman; G. E. Tyson, salesman, and J. T. Batchelor, chief clerk. The latter two were formerly in the tube sales department of Jones & Laughlin Steel Corp. at Houston.

F. D. Winslow, district sales manager for Jones & Laughlin Steel Corp. in Houston continues in that capacity, having charge of the sale of all steel products other than oil-country tubular goods.

H. E. LEWIS

J. L. SHAKELY

DEATHS

Paul C. Arnold, 48, engineer for Shell Oil Co., Inc., died March 11 at his home in Centralia, Ill.

Dr. H. A. Buehler, 67, state geologist of Missouri since 1908, died March 14 of a heart attack in Jefferson City. His home was in Rolla.

Willis Connelly, 76, retired oil man, died recently in El Dorado, Kans. He had served as head of the land department of Pure Oil Co. in Tulsa.

R. S. Snodgrass, 37; **C. R. Beindorff,** 44, and **Calvin G. Williams,** 28, all in the service of Superior Oil Co., met death March 11 in an airplane accident. Snodgrass, comptroller, resided in Los Angeles; Beindorff, pilot, in Chicago; Williams, aviation mechanic and copilot, in Houston. The crash occurred 3 minutes after the plane took off at El Paso, Tex., for Las Vegas, Nev.

Robert F. Ulrick, 77, for 21 years foreman in the coke department of Sinclair Refining Co., Houston, until his retirement a year ago, died March 14 in that city.

Rodney Alexander, employed by the Sterling division of Quaker State Oil Refining Corp. as head of its tanners' specialties department, died recently of a heart attack in his room in a Buffalo hotel, where he resided. He had served as secretary of Pennsylvania Grade Crude Oil Association.

William McIntosh, 91, for many years manager of Canada Crude Oil Producing Co., Petrolia, Ont., and one of the organizers of Petrolia and District Crude Oil Producers Association, died recently.

Frank F. Spraker, 71, retired oil driller of Tulsa, died March 19 in a Tulsa hospital. He went to that city many years ago from Allegany, N. Y.

William L. Barnes, 58, former employe of Sinclair Prairie Oil Co., died March 17 in Shawnee, Okla.

Russell W. Plank, of Pratt, Kans., division compressor station superintendent at Iuka, Kans., for Panhandle Eastern Pipeline Co., died March 6 in a Dodge City, Kans., hospital. He joined Panhandle Eastern in 1930, served as chief engineer at Liberal station, Kansas, and Glenarm station, Illinois, and was made division superintendent in 1938.

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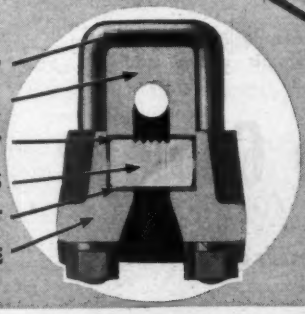

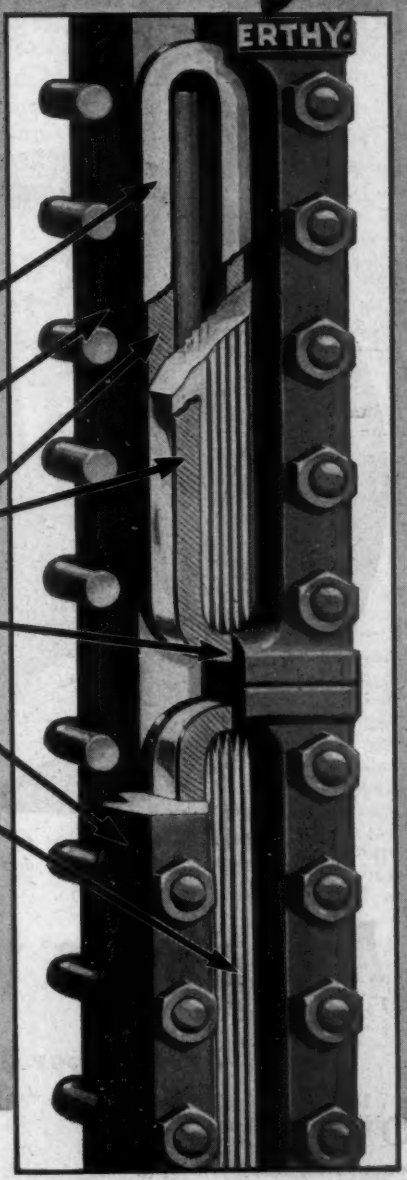

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A. Roger Denison, chief geologist for Amerada Petroleum Corp. and president of the A.A.P.G., drafting his annual address

A Challenge to Geology

by A. Roger Denison

ON the occasion of this second wartime conference of petroleum geologists, it is well to make a reexamination of the science of geology and its application to the art of prospecting for minerals. First, let me give you a definition of the science as a background for later remarks. Geology has been variously defined, but in its broadest and simplest definition it is "The Science of the Earth." In its application it deals almost entirely with the outer crust of the earth. A definition which describes the science and indicates the application is as follows:

Geology is the study of the earth's constitution, history and structure as disclosed by the sequence of rock formations and the evidence of their deformation and alteration. The purpose of this study is the discovery and evaluation of those minerals useful or necessary for our civilization.

Such a definition includes the many fields of specialization which have grown up with the science. One of the most important of these fields is stratigraphy, sometimes called historical geology. This has for its province identification of the chronological successions of rocks and their correlation. It must rely on paleontology for evidence from fossil remains and on petrology for composition, texture and mineral content in order to establish this succession. The earliest work of the geologist was concerned with the correct succession of rock formations and it still remains a field of primary concern to all geologists.

Fields of Specialization

Both because of the greater value of their contained minerals and the greater ease of identification and correlation, sedimentary rocks engage the attention of all geologists. The field of specialization which is now called sedimentation is rapidly becoming an invaluable aid in stratigraphy. This field has for its study the processes and agencies through which layers of sediments are deposited and built up into formations. It is frequently true that the proper succession of rocks can only be established by reconstructing the environment, agencies, and processes prevalent during the deposition of a particular layer of sediments.

All rocks undergo change after original formation. This may involve nothing more than simple compaction owing to overburden or it may bring such complete alteration as to leave little evidence of the original form and character of the rock. Physical or dynamical geology is the name commonly applied to the field of specialization which seeks to establish agencies and processes which bring about these changes. The name physical geology in its restricted sense denotes the application of the principles and laws of physics and chemistry to the change which rocks undergo, both deep in the earth and at the surface.

In addition to physics and chemistry whose principles and laws are directly applied to problems of geology, numerous other sciences must be used for collateral aid. For example, botany, zoology, and other biological sciences supply knowledge of liv-

ing plants and animals to aid in deciphering the history of organic evolution left by fossil remains. Mathematics, particularly geometry and trigonometry, enables one to think in the three dimensions required to visualize the shape of folded beds.

And so we arrive at my understanding of geology, "The Science of the Earth." That science which makes use of all the other sciences in unraveling the mysteries and complexities of rocks of the earth and in winning from it the minerals which are the foundation of civilization and progress on this earth.

Science Challenged

With this view of geology the conditions in the world today constitute the greatest challenge the science has ever faced. War brings destruction—and loss. Destruction of property, loss of lives. War — modern war — cannot be waged without minerals, minerals in far greater quantities than in peacetime. War destroys minerals—peace makes use of minerals. Consider only one item of destruction, the irretrievable loss of ships and their cargoes now lying on the bottom of the oceans throughout the world. Peace makes use of minerals in the form of energy or machines to make other products useful and usable by mankind. The minerals and machines which go to war are for the destruction of man and the things which mankind has produced. It is true that following the war many metals now in war machines can be salvaged and returned to peacetime use, but what of the minerals and power used to activate these machines—the oil products, for example, used to propel the war machines. These products are lost forever—they have served only to require the use of other minerals, fuels and energy to rebuild what they have torn down.

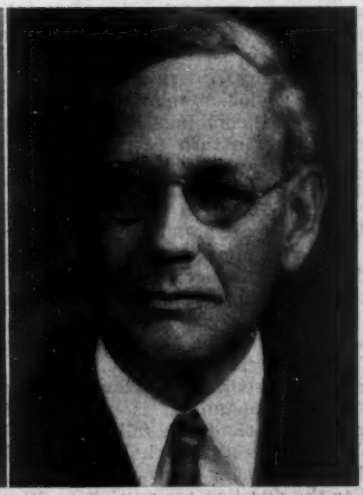
At the beginning of this war deposits of all common minerals in North America were adequate for many years of peacetime pursuits. After 4 years of accelerated war use, there is a rapidly approaching end to the known deposits of high-grade iron and aluminum ores—our known and proved oil deposits are being used at a far greater rate than new supplies are being found. The challenge to the science of geology is: Can its application to mineral exploration discover the new deposits needed to supply the deficit created by war and provide an ample reserve for unhampered progress in peacetime?

The present we are proud to regard as the "machine age." The development of a machine age is possible only with an abundant supply of cheap power and energy which is today obtained almost exclusively from mineral fuels. The most useful, the most universally adaptable of all mineral fuels are the liquid and gaseous products of petroleum and natural gas. They are the prime energizers of the war machine as they were of many peacetime pursuits. Thus the winning of the war and the rebuilding in peacetime to follow are dependent on adequate supplies of petroleum. The challenge to geology thus falls heavily on petroleum geology and, therefore, on us, who constitute the exploration branch of the petroleum industry.

The rise of the machine age has been clearly the result of the discovery and use of petroleum products. In this machine age our own United States has been and is without question the world leader. This is by no means an accident—rather it is the result of an earlier adaptation and a

THIS SPECIAL SECTION:

Contains selected papers, extended digests and author's abstracts of discussions presented this week at Dallas before the annual meeting of the American Association of Petroleum Geologists and affiliated organizations, Society of Exploration Geophysicists and the Society of Economic Paleontologists and Mineralogists. Record attendance and the international scope of papers attest to the paramount interest now focused on oil exploration.



Speakers and presiding officers included A. I. Levorsen, Tulsa consultant, who presented a survey of geological students at a meeting of the research committee; Ira H. Cram, Pure Oil Co., presided at the first joint session of the three societies, and W. E. Wrather, director of the U.S.G.S., who explained the survey's wartime functions

J. Harlan Johnson, Colorado School of Mines, Golden, president of the Society of Economic Paleontologists and Mineralogists, presided at business and technical sessions of the group and presented a paper on "Calcareous Algae as Useful Microfossils"; W. R. Rust, Jr., Humble Oil & Refining Co., presided at one of the S.E.G. technical sessions, and John L. Rich, University of Cincinnati, Ohio, outlined geology of South America

more extensive use of liquid mineral fuels. The United States since 1859 has led the world in the production and use of petroleum and its products. At the end of 1943 the United States had produced and largely consumed 64 per cent of all petroleum produced in the world, although having less than 8 per cent of the world's population.

The discovery of adequate supplies of petroleum would have lagged far behind the needs of this country without the application of geology—"The Science of the Earth"—to the problems of petroleum exploration. In truth, then, it can be said that the present high state of our industrial development is due to the acceptance and use by the petroleum industry of geology.

This acceptance of geology in the petroleum industry has led to the training and use by American companies of more geologists than all the rest of the world combined. These trained men have in turn been sent to foreign countries where they have been responsible for the finding of a majority of the oil fields of the world. It is perhaps not an overstatement to say that fully three-fourths of all the oil that has been produced, and that which is now known and proved was found by American geologists. We have, then, in the United States that group of trained scientists which, to use a current phrase, have the "know how" to find petroleum. It is upon these that today's challenge falls.

How shall we meet this challenge during the war—during the peace to follow? For the duration we must try to do more with less. More than 600 of our members and perhaps 1,500 geologists of all classes are in the armed forces. We can expect few of these to return to civilian life until the war is over. We can expect only a very small number of new men entering the profession. Nearly all college graduates in the past 2 years have gone directly to the armed forces. The students now registered in geology number less than 200 compared to a peacetime enrollment of 2,500. Until February 15, 1944, no student of geology could be deferred under selective service to continue his studies. Thus, about 2,500 petroleum geologists are now called on to find each year a greater quantity of petroleum than was found by the efforts of more than 3,000 in peacetime. Favorable sites for petroleum prospecting are becoming increasingly hard to find each year. There is an unknown but finite number of petroleum deposits—each one discovered leaves one less to be found. If there are 10,000 needles in a haystack the last 1,000 will require infinitely more search than the first 1,000.

Redoubled Effort Needed

This clearly adds up to renewed and redoubled effort on our part today. We must constantly add to our knowledge and application of every aid to prospecting. New areas must be found in which to apply our known and proved techniques. Old areas must be restudied in the light of today's concepts, applying the wealth of deductive reasoning accumulated by our experience during the past years. Areas which when previously studied failed to reveal favorable conditions for prospecting must be reexamined to determine if new methods of prospecting, new knowledge of sedimentation and stratigraphy will make the areas attractive.

Lacking sufficient manpower to mine large "new deposits" of geological information, we must dig into the "dump piles" of heretofore discarded geological information and in the light of new ideas and concepts decide which dump pile will yield economic returns under the present world conditions.

Our search for oil from the first application of the science has been dominated by structural thinking. Our work has been largely devoted to finding a trap sealed by anticlinal closure, this in spite of the fact the world's largest oil fields both in size and in total production are not anticlinal accumulations. In fact, one well-known authority states that less than one-half the known oil deposits are in true structural traps.

We must constantly increase our knowledge of the relation of oil deposits to sedimentation so that we can direct our thinking toward the finding of oil where there is little positive structural evidence, but where sedimentation, stratigraphic sequence and a suitable reservoir rock combine to form a trap for petroleum.

Geology as applied to petroleum exploration has long since passed from a study of that visible on the earth's surface to that which is under cover and, therefore, is invisible. We are working more and more "in the dark," a darkness lighted only by the occasional beams of light where the earth's form and structure are revealed by information obtained from prospect drilling, and by the structural configuration and stratigraphy of buried horizons revealed by geophysical prospecting.

Such beams of light do not find oil fields; the conditions they reveal must be correlated and translated into

(Continued on page 82)

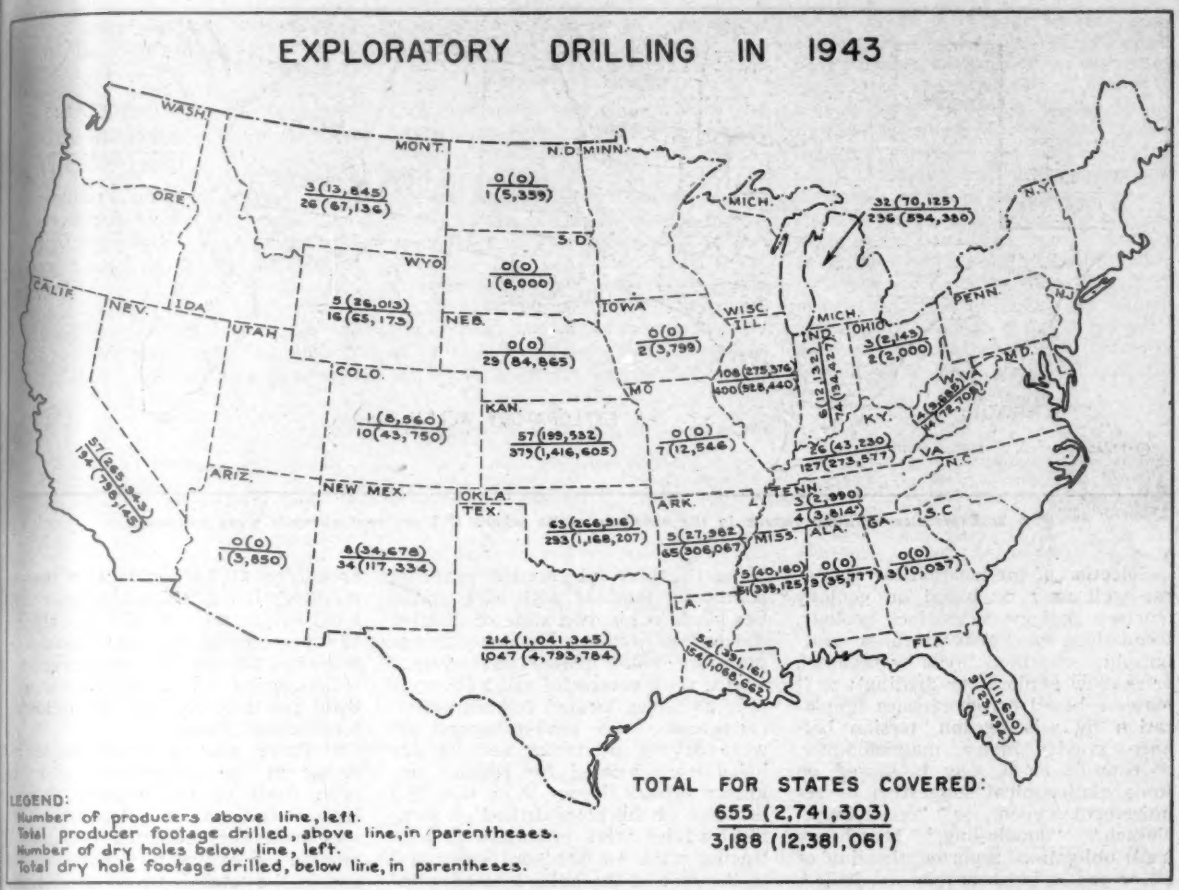


Fig. 1: Results of exploratory drilling for 1943 in 27 states, showing 655 successful wells

Wildcat Wells 17 Per Cent Successful

by Frederic H. Lahee

EXCEPT where otherwise designated, the statistics recorded in this paper are similar to those used in our reports for 1939 to 1942, inclusive. In other words, we include wildcats (both new-field wildcats and new-pool wildcats), outpost wells, and deeper-pool tests. For the first two groups we use the total footage drilled in each hole, whether a producer or a dry hole, but in the case of the deeper-pool tests we include only the footage drilled below the deepest producing horizon penetrated by the well. These 1943 figures may be consistently compared with those published in our reports of 1939 to 1942.

On the maps (Figs. 1 and 2), numbers in parenthesis indicate total footage drilled; figures preceding parenthesis indicate the number of holes drilled; figures above the cross line are for producing wells, that is, oil, oil and gas, distillate and gas, and gas; and figures below the cross line are for dry holes.

In the states covered in this review, as shown in Fig. 1, and listed in Table 1, during 1943 a total of 15,122,364 ft. was drilled in 3,843 exploratory holes, divided as follows:

655 producers	2,741,303 ft.
3,188 dry holes	12,381,061 ft.

Frederic H. Lahee, chief geologist for Sun Oil Co., Dallas, was born in Hingham, Mass., in 1884, received his B.A. degree from Harvard University in 1907, his M.A. in 1908, and his Ph.D. in 1911. He was an instructor at Harvard from 1909 to 1912. He became geologist for Sun in 1916, after teaching geology for 3 years at Massachusetts Institute of Technology.

This means that 17.0 per cent of the holes drilled, and 18.1 per cent of the footage drilled, was successful in 1943. One producer-foot was drilled for every 4.51 ft. of dry hole. One successful well was drilled for every 4.88 dry holes. The average depth of hole was 3,935 ft.

In the southern states district (Fig. 2), in 1943, a total of 8,227,468 ft. was drilled in 1,656 holes, divided as follows:

287 producers	1,546,956 ft.
1,369 dry holes	6,680,512 ft.

In this area, then, 17.3 per cent of the holes drilled, and 18.8 per cent of the footage drilled, was successful. One producer-foot was drilled for every 4.32 ft. of dry hole. One successful well was drilled in every 4.73 dry holes. The average depth of hole was 4,968 ft. For comparison with statistics for this same area in 1938, 1939, 1940, 1941, and 1942, see Table 2.

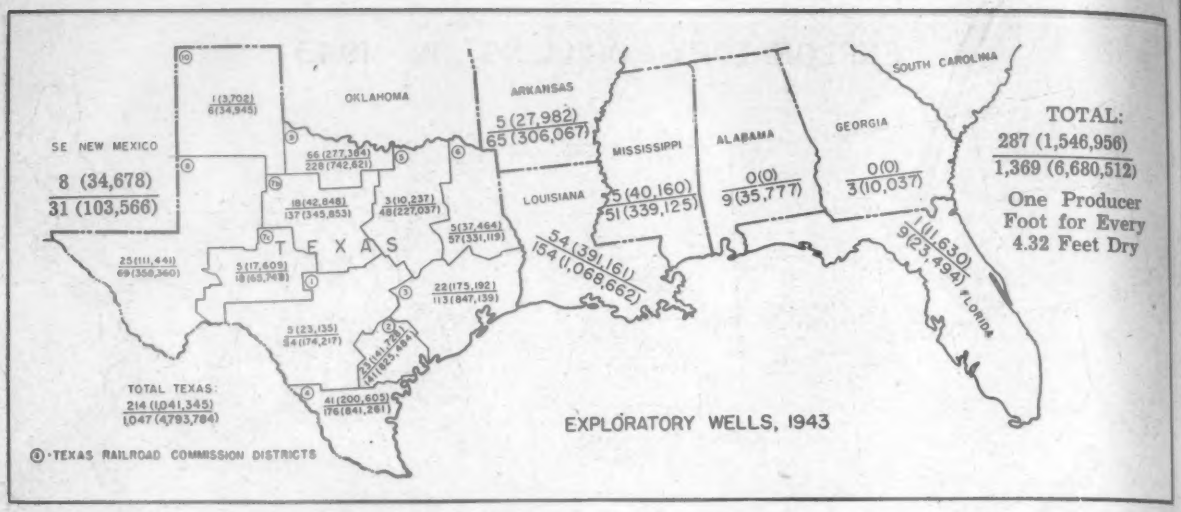


Fig. 2: Exploratory drilling results in the southern states where 17.3 per cent of wells were successful

Selection of the location for a wildcat well may be based on geology (surface geology, subsurface geology, trend along known structural or stratigraphic conditions, local or regional, or shallow exploratory drilling); or it may be based on geophysics (exploration by seismograph, torsion balance, gravity meter, magnetometer, et cetera); or it may be based on some nontechnical suggestion or requirement, such as "creekology," "hunch," "doodle-bug," promotion, lease obligation, reported showing of oil or gas in holes previously drilled, et cetera. In many cases the reason for choosing the location can not be ascertained.

In Table 3 are listed the reasons for drilling the exploratory holes in 1943, using the best information available from men familiar with such statistics, each in his own state or district. According to these figures, 626 exploratory holes drilled on technical advice were successful and 2,616 were dry; 23 holes, located for nontechnical reasons, were producers, and 500 were dry; 6 producers and 72 dry holes were located for reasons unknown. These figures show that 19.3 per cent of the holes drilled on technical advice were producers as contrasted with 4.4 per cent successful in the case of the holes located without technical advice. Therefore, in 1943, locations based on technical recommendations were nearly 4.4 times as successful as those drilled without such advice. In the southern states area (Fig. 2) 5.4 per cent of the exploratory holes, located without technical advice, were producers, whereas 18.6 per cent of the holes located on technical advice were producers.

Comparing last year's figures with those for 1943, we note the following conspicuous changes:

1. There was a considerable increase in the exploratory effort in most parts of the country, but in Illinois, Indiana, and Nebraska there was a marked reduction both in the number of exploratory holes drilled and in the total depth of these holes.

2. There was a decrease from 5,013 ft. to 4,239 ft. in the average depth of the holes drilled in California. It is noteworthy that last year also California showed no increase in average

TABLE 1—Number of Oil Wells, Gas Wells, and Dry Holes Drilled as Exploratory Tests in 1943

State—	Oil producers		Gas producers*		Dry		Total number holes	Total footage drilled	Average depth of hole (ft.)†
	No. of holes	Footage drilled	No. of holes	Footage drilled	No. of holes	Footage drilled			
Alabama	0	0	0	0	9	35,777	9	35,777	....
Arizona	0	0	0	0	1	3,850	1	3,850	....
Arkansas	5	27,982	0	0	65	306,067	70	334,049	4,772
California	44	197,965	13	67,378	194	798,145	251	1,064,088	4,239
Colorado	0	0	1	8,560	10	43,750	11	52,310	....
Florida	1	11,630	0	0	9	23,494	10	35,124	....
Georgia	0	0	0	0	3	10,037	3	10,037	....
Illinois	107	274,255	1	1,121	400	928,440	508	1,203,816	2,369
Indiana	6	12,132	0	0	74	134,427	80	146,559	1,832
Iowa	0	0	0	0	2	3,799	2	3,799	....
Kansas	56	198,266	1	1,255	379	1,416,605	436	1,616,137	3,707
Western Kentucky	25	42,440	1	790	127	237,577	153	516,807	2,071
Louisiana	30	180,245	24	210,916	154	1,068,662	208	1,459,823	7,018
Michigan	24	50,223	8	9,902	236	594,380	268	654,505	2,479
Mississippi	5	40,160	0	0	51	339,125	56	379,285	6,775
Missouri	0	0	0	0	7	12,546	7	12,546	....
Montana	1	5,040	2	7,805	26	67,136	29	80,981	2,792
Nebraska	0	0	0	0	29	84,865	29	84,865	2,926
New Mexico	7	25,086	1	9,592	34	117,334	42	152,012	3,619
North Dakota	0	0	0	0	1	5,350	1	5,350	....
Northwest Ohio	1	1,479	2	664	2	2,000	5	4,143	....
Oklahoma	48	211,169	15	55,604	293	1,168,207	356	1,432,980	4,025
South Dakota	0	0	0	0	1	8,000	1	8,000	....
Tennessee	0	0	3	0	4	6,804	7	6,804	....
Texas	183	752,053	51	169,292	1,047	4,793,784	1,281	5,835,129	4,557
West Virginia	1	2,160	3	7,525	14	72,708	18	82,393	....
Wyoming	5	26,013	0	0	16	65,173	21	91,186	....
Total	529	2,069,298	126	672,005	3,188	12,381,061	3,843	15,122,364	3,935

*Gas-and-distillate (condensate) wells, of which there were 37 completed in 1943, are included in this column.
†Averages have been recorded here only for states where more than 25 exploratory holes were drilled in 1943.

depth of exploratory hole drilled. 3. On the other hand, deeper drilling is proved by marked increases in the average depths of exploratory holes in Kansas, western Kentucky, Louisiana, Mississippi, New Mexico, and in Texas.

As in the past 2 years we are again submitting herewith special tables relating to the following 11 states: Arkansas, California, Illinois, Indiana, Kansas, Louisiana, Michigan, Mississippi, New Mexico, Oklahoma, and Texas. In Table 4 are shown statistics on exploratory holes (previously all listed as wildcats, and so called), and in Table 5 are statistics on proved reserves in the area of these same 11 states.

Measure of Success

If, for each year, we divide the newly discovered proved reserves (C, Table 5) by the number of exploratory holes drilled in that year, or by the total exploratory footage drilled in that year, we shall have a measure of the degree of success of exploratory drilling in terms of newly discovered proved reserves (G and H, Table 5); and if we divide the total new proved reserves (discoveries plus revisions plus extensions (E, Table 5) by the number of exploratory holes drilled, or by the total exploratory footage drilled, we shall have a rough measure of the degree of success of the exploratory effort (I and J, Table 5). Under G and H the measure is short. Under I and J, the measure may be too large or too small. In any case, there is an unavoidable error in estimating rate of discovery, or degree of success in wildcatting, measured in terms of new reserves. But the figures obtainable by these methods, as here described, are a significant index. As shown graphically in Fig. 3, they reveal a marked drop in the rate of discovery from 1937 to 1943, inclusive, and this

TABLE 2—Comparative Statistics for All States Shown in Fig. 2*

	Producers drilled				Dry holes drilled				Total exploratory holes	Feet drilled	Average depth (ft.)	Dry-hole feet drilled for each producer (ft.)
	Holes		Footage		Holes		Footage					
	Number	Per cent	Feet	Per cent	Number	Per cent	Feet	Per cent				
1938	200	13.6	984,262	17.4	1,271	86.4	4,667,402	82.6	1,471	5,651,664	3,842	4.74
1939	161	12.6	779,345	14.8	1,113	87.4	4,501,669	85.2	1,274	5,281,014	4,145	5.90
1940	187	12.8	919,506	†14.9	1,279	87.2	†5,251,273	†85.1	1,466	6,170,779	†4,209	†5.71
1941	258	16.5	1,264,774	18.4	1,305	83.5	5,578,975	81.6	1,563	6,843,749	4,372	4.41
1942	231	16.3	1,289,480	19.6	1,186	83.7	5,295,556	80.4	1,417	6,585,036	4,647	4.11
1943	287	17.3	1,546,956	18.8	1,369	82.7	6,680,512	81.2	1,656	8,227,468	4,968	4.32

*In this table New Mexico data are from the southeastern part of the state only. †See A.A.P.G. Bulletin, Vol. 25, p. 1,938, where corrections are mentioned for these figures as they appeared in Table 2, p. 1,001, of the same volume.

TABLE 3—Basis for Locating Exploratory Holes Drilled in 1943

	Geology		Geophysics*		Geology and geophysics		Sundry nontechnical		Unknown		Total		Grand total
	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	
Alabama	...	3	...	2	...	2	...	1	...	1	...	9	9
Arizona	...	1	...	...	...	...	...	...	...	...	...	1	1
Arkansas	2	22	1	24	2	14	...	1	...	4	5	65	70
California	39	132	8	24	8	11	1	13	1	14	57	194	251
Colorado	1	5	...	1	...	...	...	3	...	1	1	10	11
Florida	...	...	...	2	1	...	...	7	...	...	1	9	10
Georgia	...	...	...	1	...	...	...	2	...	...	...	3	3
Illinois	86	280	16	54	6	32	...	34	...	...	108	400	508
Indiana	2	33	...	2	...	...	...	5	4	33	6	74	80
Iowa	...	...	...	...	...	...	...	2	...	...	...	2	2
Kansas	40	150	12	59	...	9	5	161	...	...	57	378	436
Kentucky (W)	18	25	1	9	5	34	2	59	...	...	26	127	153
Louisiana	22	70	19	44	13	37	...	2	...	1	54	154	208
Michigan	32	235	...	...	...	1	...	...	...	...	32	236	268
Mississippi	1	19	1	15	3	11	...	3	...	3	5	51	56
Missouri	...	2	...	...	...	...	...	4	...	1	...	7	7
Montana	3	22	...	...	...	...	...	2	...	2	3	26	29
Nebraska	...	...	...	15	...	4	...	3	...	7	...	29	29
New Mexico	4	22	3	6	...	4	1	2	...	...	8	34	42
North Dakota	...	...	...	...	...	1	...	...	...	...	...	1	1
Ohio (NW)	1	1	2	...	...	...	...	1	...	...	3	2	5
Oklahoma	23	129	35	89	...	6	5	69	...	...	63	293	356
South Dakota	...	1	...	...	...	...	...	...	...	...	...	1	1
Tennessee	1	...	...	...	...	...	2	4	...	...	3	4	7
Texas	128	655	51	193	27	75	7	120	1	4	214	1,047	1,261
West Virginia	4	10	...	4	...	...	...	...	...	...	4	14	18
Wyoming	4	11	...	1	1	2	...	1	...	1	5	16	21
Total	411	1,828	†149	†545	‡66	‡243	23	500	6	72	655	3,188	3,843

*Including geochemistry. †Of these holes 145 producers (123 wildcats, 22 outposts) and 508 dry holes (473 wildcats, 34 outposts, 1 deeper-pool test) were located by seismograph. ‡Of these holes, 64 producers (43 wildcats, 17 outposts, and 4 deeper-pool tests), and 239 dry holes (202 wildcats, 25 outposts, and 3 deeper-pool tests) were located by seismograph and geology.

TABLE 4—Statistics on Exploratory Holes in Area of 11 States*

	Located on technical basis				Nontechnical location				Unknown basis for location				Total				Grand total exploratory holes	Total footage		No. ft. in dry holes drilled per foot in producing exploratory wells
	Producers		Dry holes		Producers		Dry holes		Producers		dry holes		Producers		Dry holes			Producers	Dry	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.				
1937	214	16.05	1,119	83.95	17	5.80	276	94.20	48	9.21	473	90.79	279	12.99	1,868	87.01	2,147	1,188,388	7,002,875	5.89
1938	283	17.93	1,295	82.07	43	7.61	522	92.30	17	4.67	347	95.33	343	13.68	2,164	86.32	2,507	1,482,889	7,119,867	4.80
1939	216	13.33	1,404	86.67	43	6.15	656	93.85	10	4.85	196	95.15	269	10.85	2,256	89.35	2,525	1,107,395	7,344,424	6.63
1940	309	15.89	1,660	84.31	35	4.37	731	95.43	11	8.09	125	91.91	355	12.37	2,516	87.63	2,871	1,397,486	8,416,015	6.02
1941	463	20.17	1,832	70.83	29	3.92	710	96.08	0	0	55	100.00	492	15.92	2,587	84.08	3,089	2,023,184	9,222,217	4.55
1942	438	18.25	1,961	81.75	21	3.81	530	96.19	11	12.36	78	87.64	470	12.17	2,569	87.83	3,039	2,084,036	9,597,767	4.56
1943	584	19.23	2,457	80.77	19	4.41	411	95.59	6	9.23	59	90.77	609	17.22	2,927	82.78	3,536	2,623,207	11,665,176	4.44

*This area includes California, New Mexico, Texas, Oklahoma, Kansas, Arkansas, Louisiana, Mississippi, Illinois, Indiana, Michigan.

Then he said to himself
"VERY COMPLICATED, PLEASE"

Mild piece of understatement is that which Premier General Hideki Tojo made to his 83rd special session of the Japanese Diet:

*"The present war situation is very complicated. The enemy who was defeated at the beginning * * * is overcoming many difficulties and dangers."*

Of course, Tojo has read how *Recourse to Arc Welding* enabled us (his enemy) to fan out ships and planes and arms at spots which complicated his war situation.

But perhaps he has not read of the mountains of little procedures, recourse to which overcame many difficulties and dangers for our production men.

TABLE 5—Statistics on Proved Reserves in Area of 11 States*

	1938	1939	1940	1941	1942	1943	1944
A. Proved reserves as of Jan. 1 of year indicated	14,664,035,000	16,630,452,000	17,723,393,000	18,226,542,000	18,816,785,000	19,260,415,000	19,070,764,000
B. Net change in proved reserves since Jan. 1 of previous year	+2,422,150,000	+1,966,417,000	+1,092,941,000	+503,149,000	+590,243,000	+443,630,000	—189,651,000
C. New proved reserves discovered during year indicated	805,293,000	337,989,000	280,882,000	423,551,000	254,801,000	271,048,000	.....
D. New reserves added through extensions and revisions of old fields during year indicated	2,313,356,000	1,955,507,000	1,505,816,000	1,496,810,000	1,496,536,000	963,207,000	.....
E. Total new proved reserves added (C + D)	3,118,649,000	2,293,496,000	1,786,698,000	1,920,161,000	1,751,337,000	1,234,255,000	.....
F. Production during year indicated	1,152,231,000	1,200,555,000	1,283,490,000	1,329,918,000	1,307,707,000	1,423,906,000	.....
G. Newly discovered reserve (C) per exploratory hole drilled in year indicated	321,217	133,857	97,834	137,115	83,843	76,652	.....
H. Newly discovered reserves (C) per foot of exploratory hole drilled in year indicated	93.6	39.9	28.6	37.7	21.8	11.98	.....
I. New proved reserve (E) per exploratory hole drilled in year indicated	1,243,976	908,315	622,326	621,612	576,287	349,052	.....
J. New proved reserves (E) per foot of exploratory hole drilled in year indicated	362.52	271.36	182.07	170.75	140.79	86.38	.....

*This area includes Arkansas, California, Illinois, Indiana, Kansas, Louisiana, Michigan, Mississippi, New Mexico, Oklahoma, and Texas. All figures are in barrels from annual A.P.I. reports.

in spite of a steadily increasing footage drilled in exploratory holes and an increasing number of exploratory holes drilled each year. However, worthy of note is the fact that an increase in proved reserves newly discovered in 1943 resulted from the marked increase in exploratory drilling during that year. The effects of extending the newly discovered areas of 1943 should be observed especially in 1944 and 1945.

Up to this point, the statistics which we have presented are analogous to those published in our earlier articles. They relate to the several kinds of exploratory wells, all totalled together, and, although in this paper we have called these exploratory holes, or wells, in previous years we called them all wildcats. There are, of course, objections that may be raised to this system since it fails to discriminate between those holes that are drilled to search for new fields, on the one hand, and those which are drilled in fields already discovered, on the other hand. The fact is that whatever the classification of an exploratory test may be, if it is successful it will probably add materially to crude oil reserves or to natural gas reserves. Therefore, from this point of view all of these groups of exploratory holes merit consideration.

Grouping of Wildcats

We are unable now separately to classify new-field wildcats and new-pool wildcats of 1943, but we can group these together and list the data for wildcats, outposts, and deeper-pool tests. This we have done for the major groups of states in Table 6. Observe that 3,014 of the exploratory holes drilled in 1943 were wildcats, whereas 681 were outposts and 148 were deeper-pool tests. In other words 78.4 per cent of all the exploratory holes recorded in this paper for 1943 were of the wildcat class. How much variation there may be in this relation from year to year is impossible for us to say since we do not possess the data, but for convenience and probably without introducing too serious an error, we might assume that 80 per cent would be satisfactory. If this is fair, we may estimate that the number of wildcats drilled in 1942, under the same definition as that adopted in the present paper, was somewhere near 80 per cent of 3,212 or about 2,570, which would mean an increase in exploratory drilling of the wildcat class from approximately 2,570 in 1942 to 3,014 in 1943.

Whether we take the full number of exploratory holes (3,843) drilled in

TABLE 6—Distribution of Exploratory Wells of 1943 by Classes and Results of Drilling

	A. All states included in Table 1		B. Southern states included in Table 2		C.* Eleven states included in Tables 4 and 5		D.* States included in Table 1 except the 11 states in Tables 4 and 5	
	Number	Footage	Number	Footage	Number	Footage	Number	Footage
Wildcats:								
Producers:								
Oil	302	1,357,809	137	744,728	281	1,293,409	21	64,400
Gas	65	273,548	27	147,574	55	246,602	10	26,944
Gas-distillate	29	273,959	29	273,959	29	273,959	0	0
Total	396	1,905,314	193	1,166,284	365	1,813,970	31	91,344
Dry	2,618	10,514,401	1,209	5,954,078	2,376	9,852,775	242	661,626
Outposts:								
Producers:								
Oil	173	648,998	46	251,900	164	625,649	9	23,349
Gas	13	60,323	7	41,759	12	59,533	1	790
Gas-distillate	5	34,118	5	34,118	5	34,118	0	0
Total	191	743,439	58	327,777	181	719,300	10	24,139
Dry	490	1,770,045	132	683,282	472	1,719,998	18	50,047
Deeper-pool tests:								
Producers:								
Oil	54	62,491	28	40,528	50	60,478	4	2,013
Gas	11	25,903	5	3,234	10	25,303	1	600
Gas-distillate	3	4,156	3	4,156	3	4,156	0	0
Total	68	92,550	36	52,918	63	89,937	5	2,613
Dry	80	96,615	28	43,129	79	92,403	1	4,212
Total producers	655	2,741,303	287	1,546,956	609	2,623,207	46	118,096
Total dry holes	3,188	12,381,061	1,369	6,680,512	2,927	11,665,176	261	715,885

*The horizontal totals of Columns C and D equals the items in Column A.

1943, or merely the wildcat group of 3,014, both figures are far below PAW's urgent request for 4,500. There is no question that the exploratory effort must be still further intensified in 1944.

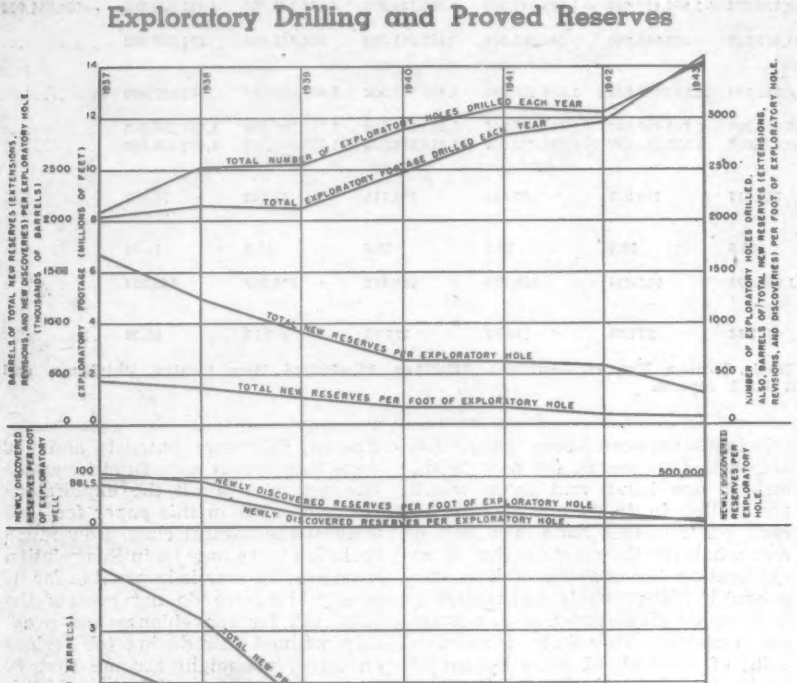

Exploratory Drilling and Proved Reserves
TOTAL NUMBER OF EXPLORATORY HOLES DRILLED EACH YEAR
TOTAL EXPLORATORY FOOTAGE DRILLED EACH YEAR
TOTAL NEW RESERVES PER EXPLORATORY HOLE
TOTAL NEW RESERVES PER FOOT OF EXPLORATORY HOLE
NEWLY DISCOVERED RESERVES PER FOOT OF EXPLORATORY HOLE
NEWLY DISCOVERED RESERVES PER EXPLORATORY HOLE
TOTAL NEW PROVED RESERVES (DISCOVERIES, EXTENSIONS, REVISIONS)
PROVED RESERVES ADDED THROUGH EXTENSIONS AND REVISIONS
NEW PROVED RESERVES DISCOVERED DURING YEAR
YEAR DURING WHICH NEW RESERVES WERE ADDED AND EXPLORATORY HOLES WERE DRILLED

Fig. 3: Showing the decline in new reserves per exploratory well

Classification of Exploratory Wells

IN the search for new crude-oil supplies and in the effort to make substantial additions to partly developed pools, holes[1] are drilled either at random or, more often in these modern times, on the basis of technical information (geological, geophysical, or both) which is never complete. Such holes are referred to as "exploratory." They do not include holes drilled within the limits of a developed pool, or of the developed part of a pool, where such drilling is carried down only to the known producing formation (or formations) of this pool. Holes of this latter class are commonly known as "field wells."

There are several types of hole of the former class, all of which are exploratory, but in varying degrees. For example, (a) there are holes which are drilled on geologic structures or in areas which have never before produced oil; (b) there are holes which are drilled on producing structures, but completely outside of the then known limits of any pools previously developed on such structures; and (c) there are holes which, although drilled within the then known boundaries of a producing pool, are carried on down to greater depths to explore for unknown possibilities below the deepest producing horizon of this pool.

In our reports of the last 4 years, covering information for 1939, 1940, 1941, and 1942, we have included these types of exploratory hole under the general category of wildcats, but, in the original statistics from which the tabular data were compiled, we listed holes of type (a) as "rank wildcats" and holes of types (b) and (c) as "semiwildcats." Previous to 1939 our figures omitted "semiwildcats" of type (c), a very small group in those days. We want especially to make these points clear because recently, in his article on wildcat drilling,[2] Dr. W. V. Howard stated that "Lahee's definition of a wildcat has become successively liberalized so that the increase" (in the annual number of wildcats reported as drilled) "may represent wells added as a result of this liberalization." For the years 1939 to 1942, inclusive, the same basis was used and accordingly the data presented for these years may be compared, with assurance that they are essentially analogous. Before 1939 there were some minor changes in our approach with the result that the totals may not be quite as closely comparable, but even here the variations amount to probably less than 5 per cent. Another point which may well be stressed in this connection is the fact that a large proportion of the statistics which have been used in these reports was collected and compiled by the same geologists from year to year, thus lessening the chance for variation in definitions due to the personal equation. In other words we believe that our data on wildcatting, as published by the A.A.P.G. in recent years, and certainly within the last 4 years, are comparable from year to year, and that they do illustrate, within a very small percentage of error, the trend of exploratory effort in the states covered.

With reference to exploratory statistics submitted by different persons and organizations, it is true that there are unfortunate discrepancies. One cannot safely compare the figures compiled under different auspices, and it is mainly for this reason that standardization of terms and classifications used in these studies is a necessity.

We earnestly believe that the main criterion for defining a wildcat should continue to be the degree of risk of failure involved in the drilling, the degree of hazard in the venture. And we believe that this criterion should be applied in classifying different types of exploratory holes.

References

1. Although "well" is better used for a hole that has been completed as a producer, in the present paper we are using "hole" and "well" synonymously. In some parts of this paper "test" is used for a hole not completed as a producer.
2. "Wildcat Drilling Has Failed to Keep Up With Increasing Need of Discoveries," The Oil and Gas Journal, Feb. 17, 1944, pp. 41, 42.

CLASSIFICATION OF EXPLORATORY DRILLING FOR PETROLEUM

FOR statistical purposes, petroleum is defined as including crude oil, natural hydrocarbon gas, and the condensate content of natural gas, wherever these occur under natural conditions.

Occurrence of Petroleum

1. A pool, as used in the following dis-

clusion, is an underground accumulation of petroleum in a single and separate natural reservoir. It is characterized by a single natural pressure system so that production of petroleum from one part of the pool will affect the reservoir pressure throughout its extent. In all directions a pool is so bounded by geologic barriers that it is effectively separated from any other pools that may be present in the same district, or on the same geologic structure.

2. A field may be a single pool, or it may consist of two or more pools, all on, or related to, the same geologic structure. Where there is more than on pool in the same field, the several pools are separated from one another through geologic causes such as synclinal conditions, faulting, pinching out of reservoir beds, and changes in porosity and permeability. The pools may occur at several horizons of different geologic age, separated by relatively impervious strata, and in such cases they may directly, or only partly, overlap one another in a horizontal sense; or they may not overlap at all.

Classification of Drilling

1. Development drilling, in the petroleum industry, is the drilling of wells within, or close to, the limits of a producing or producible pool, as these limits are known at the time of this drilling, the object being to complete such wells in the pay horizon of the pool.

2. Exploratory drilling is (a) the drilling of wells relatively a considerable distance outside the limits of developed, or developing, pools as these limits are known at the time of such drilling; or (b) the drilling of wells within the then known limits of a pool with the object of searching for new producible horizons below the producing (or producible) horizon of the pool; or, if there are two or more superposed pools in the field, below the producing or producible horizon of the deepest pool penetrated by this well.

Classification of Wells

1. Under the head of "development drilling" may be listed field wells. A field well is a well drilled with the object of further exploiting the pay horizon of a pool within the area which has already been essentially proved for production in this pool. Such a well may be inside the pool as already outlined by producing or producible wells, or it may be a relatively short distance outside these limits.

2. Under the heading of "exploratory drilling" we may list these classes of wells: wildcat wells, including new-field wildcats and new-pool wildcats, outpost wells, and deeper-pool tests.

A. A wildcat well is a well located relatively a considerable distance outside the limits of producing or producible pools as these limits are known at time of its drilling. A new-field wildcat is a hole drilled on a geologic structure or in a geologic environment where petroleum has not yet been discovered. A new-pool wildcat is a hole drilled on a structure, or in a geologic environment, where other pools have been found, but where the complexities in the underground geologic conditions are so great that searching for a new pool is very hazardous.

Definitions given in this portion of Lahee's paper deal with one of the most controversial issues currently under study by the industry. Efforts of the Petroleum Administration for War to develop standard definitions for wells of various types at a 2-day meeting in Washington several weeks ago ended without resolving the question. In presenting Lahee's definitions, the Journal realizes that numerous authorities are in disagreement but they are submitted as proposals by the author. Several of the more extended comments which followed the accompanying definitions in the complete version of the paper were deleted in this condensation.

B. An outpost well is a hole drilled with the thought that it will probably extend, by a considerable distance, a pool already partly developed. Its original objective is the producing horizon of this pool, although it may be completed or abandoned at a higher, or at a lower, stratigraphic horizon. It is far enough from the limits of the pool, as known at the time when its drilling is started, to make its outcome uncertain, but it is not far enough from these limits to be designated a wildcat. If it is successful in its original object, it will add materially to the productive area of the pool. It may be dry.

C. A deeper-pool test is a well located within the known limits of a pool and drilled with the object of searching for new producible horizons below the producing or producible horizon of the pool; or, if there are two or more overlapping pools, below the producing or producible horizon of the deepest pool penetrated by this well.

TABLE A—SUMMARY OF CLASSIFICATION

A	B	
Classification when drilling is started	Classification after completion or abandonment—	
	Successful	Unsuccessful
Development drilling—		
Field well	Field well (sometimes discovery well of a new pool above the known pool. May then be called a shallower-pool test).	Field dry hole
Exploratory drilling—		
Wildcat		
New-field wildcat	Discovery well of a new field.	
New-pool wildcat	Discovery well of a new pool on a structure already producing. Sometimes a new-pool wildcat, and very rarely a new-field wildcat, may turn out to be an unexpected extension of an old pool.	Wildcat dry hole
Outpost well	Extension well. (Not infrequently may turn out to be the discovery well of a new pool although in its drilling the expectation was that it would extend an old pool).	Dry outpost well
Deeper-pool test	Discovery well of a new pool below an old pool within the limits of which the well was drilled.	Dry deeper-pool test (in some cases may be plugged back and completed as producing well in regular pay of the pool).

TABLE B—STATISTICS ON EXPLORATORY WELLS

STATE or DISTRICT	WILDCAT WELLS*				OUTPOST WELLS				DEEPER-POOL TESTS				TOTALS			
	Discovery		Extension	Failure	Discovery		Extension	Failure	Discovery		Extension	Failure	Discovery		Extension	Failure
	Oil	Gas	Oil Gas		Oil	Gas	Oil Gas		Oil	Gas	Oil Gas		Oil	Gas	Oil Gas	
SUB-TOTAL																
TOTAL	WILDCATS.....				OUTPOSTS.....				DEEPER-POOL TESTS.....				TOTALS.....			

*If desirable this column may be divided under new-field wildcats and new-pool wildcats; or a symbol may be shown against each entry under "wildcat wells" to distinguish between these two subgroups.

Results of Drilling

As results of drilling we may designate wells as dry holes, as extension wells, or as discovery wells.

1. Any hole—even a well drilled within the known boundaries of a pool as a "field well"—may be abandoned as dry. However, the chances are that field wells will produce, or be producible; and although the risk is greater, outpost wells have a fair chance of success; but wildcats, according to statistics, have less than one chance in five or six of discovering oil or gas "in substantial quantities."

2. Any well which is drilled as an outpost well or as a wildcat will be classified as an extension well, if it extends the productive or producible area of a pool, but this classification cannot logically be applied until after the fact is demonstrated, and such demonstration may require the drilling of several intermediate wells.

3. Any wildcat, outpost, or deeper-pool test, that discovers a new pool of petroleum, is a discovery well. Likewise a field well that opens a new shallow pool may be classed as the discovery well of this pool. On this basis discovery is not necessarily wholly limited to exploratory wells.

4. The date of discovery of a pool is the date on which the discovery well of the pool is completed as a producer of petroleum. For a field this would be the date of discovery of the first pool in the field. If the first well completed in a pool happened to be in the gas cap of an oil pool, this would still be the discovery well of the pool as a whole, including both gas and oil.

Statistics on Exploratory Drilling

In order that the statistics of exploratory drilling may be as consistent as possible between different areas and in order that hose in successive years may be as nearly comparable as possible, the foregoing definitions have been suggested for general adoption. In applying these definitions there is bound to be some question in a few border-line cases, but for the most part classification should be made without difficulty.

Bear in mind that preliminary classification is based on the degree of risk of failure as estimated when drilling of the hole is commenced, and this risk is contingent on how much is known of underground geological conditions when drilling is started. Also remember that preliminary classification of a well, made before the well is completed, cannot logically include reference to discovery or extension. Classification under Column A in Table A are fixed and must not be changed. On the other hand, classifications under Column B may have to be changed as more information becomes available. Thus, a wildcat, at first listed as a discovery well may later be proved to be an extension well.

The several types of well, both development and exploratory, are summarized in Table A.

In tabulating statistics on exploratory wells it is very important that each of the three groups, wildcats, outpost wells, and deeper-pool tests be listed separately so that the totals for each group may be intelligently studied and compared. If desired, wildcats can be subdivided under new-field wildcats and new-pool wildcats. For an over-all picture, the several sets of figures may be totaled, but if only a grand total of all these figures is presented, serious misinterpretations are easily possible.

As a form to be used in tabulating we suggest Table B, in which, in addition to the list of states or districts, there are three major vertical columns, for wildcats, outpost wells, and deeper-pool tests, respectively. Each major column is subdivided into three minor columns for discovery wells, extension wells, and unsuccessful wells (dry holes or failures). Under each minor column can be tabulated either the number of holes of the particular group and sub-group, or the total footage of these same groups and sub-groups.

To each wildcat and outpost well, its total footage is to be assigned and listed; but, as above explained, each deeper-pool test is to be credited with only that footage which was drilled below the pay horizon of the deepest pool within the limits of which it was drilled. In no case should footage penetrated in sidetracking, or in redrilling of a lost hole, be included in the total footage of any hole.

A hole temporarily abandoned should not be listed in one year's record, and then again in succeeding years, each time it is drilled a little deeper. As far as can be determined, it should be listed only when it has been permanently abandoned. Where, after a long lapse of time, a hole recorded as permanently abandoned, is cleaned out and drilled deeper, it should be so designated as an exception in the later listing, and only the additional footage drilled should be assigned to it as of the year during which it was thus deepened.

A Challenge to Geology

(Continued from page 68)

earth history. The more adequate the data available the more completely can the history be written. Unfortunately the complete earth history having a bearing on an individual oil deposit is never known. The approach is made as the field is completely drilled up. We are, then, called upon to write the synopsis of a book in which many pages are missing. Our task is to select the most reasonable assumptions which will bridge the gap caused by these missing pages.

By far the great majority of all men who have ever worked in petroleum geology are still in the profession—so young is the application of the science. The backlog of experience represented by this group of men is the greatest asset in accepting the challenge to find additional oil supplies. We must now call on this accumulated experience to apply the knowledge required in the more intensive search called for today.

With the coming of peace our plans and programs must undergo great expansion and definite alteration. Then we will have added manpower with the return of those formerly in the industry, and we will have, after a short time, a large number of new recruits from our colleges and universities. This enlarged staff will be put to work on an accelerated program of exploration. Many types of research suspended or diverted during the war can be resumed and new work started. The vast array of unsolved problems accumulated during the shortage of manpower will be studied and solved. In this way the missing pages in Earth History will be rapidly added at an ever-increasing rate.

This accumulation of knowledge will not be confined to the United States nor even to the Western Hemisphere. Vast areas of the world remain where earth history virtually is unknown and where the surface itself has not been examined. From the great American reservoir of "know how" in petroleum exploration will flow the men, equipment, and material with which to find the deposits of petroleum needed in ever-increasing quantities to continue our machine-age economy and extend its benefits to other parts of the world.

Manpower Problems

(Continued from page 60)

to 25-year critical range for the draft, but since there are only three key jobs in the average party apt to be held by such young men the drafting of 200 or 300 men would almost wreck geophysical exploration work.

The profession is young and has attracted young men who must have a thorough technical education and then learn by practical experience how to interpret the information their instruments reveal. Reconnaissance work takes them generally into areas where physical ruggedness is required and living conditions are frequently uncomfortable. If a substantial percentage of the men left are drafted geophysical exploration will not only diminish considerably in volume, but the results of exploration work will suffer even more, due to spreading manpower too thinly.

Comparable data on young geologists has not been gathered and developed as thoroughly as the geophysicists. Because much larger numbers are involved and more companies employ them. But a sampling of some of the major companies developed information that about 10 per cent of their geologists are subject to possible draft. These companies thought the percentage for total industry would be higher, since larger companies usually have higher percentage of older men on geological staffs than smaller companies.

General concern was expressed because exploration is now recognized as the industry's major problem. There is a feeling that just as heaviest burden of petroleum's war problems shifted to exploration, staffs of trained men, already badly thinned by 2 years of war, would receive a body blow. Although relatively few of these young technicians have been drafted thus far, large numbers of them have already volunteered, or are being called up as reserve officers. About one-fourth of all exploration men have already gone to war, with those remaining carrying double normal work, and the immediate future demands a large increase over present work load. Any attempt to spread technicians too thinly over increased exploration work load will cause rapid deterioration in quality of results and be the forerunner of substantial wastes of manpower and materials in wildcat wells drilled on the basis of degraded quality of geological and geophysical interpretative work.

Geophysics Looks Forward

by R. D. Wyckoff

Here is an extended digest of the presidential address at the annual meeting of the Society of Exploration Geophysicists clarifying many of the misconceptions about adaptability of war instruments to the field of petroleum exploration. The author concludes that improved instrumentation is the only significant development geophysicists can expect from the war.

THE extra demand for oil imposed by war consumption, is minor in light of the total quantity of oil taken from the ground in the past and that likely to be taken by future production, but it has been a warning that has jarred us out of our normal complacency and highlighted exploration as the bottleneck of our domestic petroleum industry.

It is implied that our methods are inadequate, perhaps antiquated and have not kept pace with other technological developments. There are also many vague rumors about wonders and marvels to be expected in the postwar period as a result of applications of so-called revolutionary secret advances made in connection with military weapons. Both of these ideas are false.

Geophysical methods, like most geological methods find structure, not oil, and from a technical viewpoint must be judged accordingly. Given virgin territory in which to operate, modern and properly executed geophysical methods have not failed to bring results measuring up to modern technological standards. Recently, however, a large part of our domestic geophysical exploration has been devoted to reworking areas thoroughly combed in the past, using improved techniques. But a rework job is still a rework job, and carries the inevitable penalty of diminishing returns. Much of the domestic work that has been done in virgin territory on the other hand, is either marginally prospective, or as yet has been inadequately tested.

Such considerations, however, do not alter the fact that in view of the prospective demands for oil and the present state of our proven reserves, our methods are indeed inadequate. It is frankly admitted that our problem is to find oil, not merely prospects, particularly not just structural prospects, for which we now have fairly good finding tools. We are told that the bulk of our future domestic reserves probably lies in stratigraphic or even lithographic traps, and that it is up to the exploration department to find such oil. The direct approach would be to design instruments capable of detecting oil directly and thus solve the problem.

This is not a bad star at which to aim, but at this time it is still only a dream and the industry must frankly recognize this fact. In these days, the gradual release of scraps of information about the almost magical performance of innumerable "gadgets" of war has led many people to believe that out of the war will come the long-sought magic needed by the scientists to locate oil directly in place under the surface of the earth. In order to be realistic about our exploration problem, I must first eliminate these delusions, for delusions they are and the fact is that geophysics has probably contributed more to the war than the war has contributed to geophysics.

Out of the war, geophysics will gain by improvements in instrumentation, but other than the improved performance that inevitably accompanies improved instrumentation, I see no new geophysical methods coming out of the war. Radar has captured the imagination of the layman and has given rise to the wildest dreams, but despite its astounding performances, radar, in principle is not new, only the instrumentation is new. It is reflection radio made possible by war requirements and rapid strides in electronics, analogous to the reflection seismograph that emerged from the refraction seismograph.

Instrumentation Improvements

The analogy goes even further, because the reflection seismograph is actually "radar" in principle, except that elastic waves are used instead of electromagnetic waves because elastic waves will penetrate the earth to useful distances and radar electromagnetic waves will not. One might suggest that the use of lower frequencies will permit greater penetrations, but then we see that we are back to the almost endless variations in electrical prospecting methods that have been used for years and are still the subject of experiments in the hope of providing a tool that will find oil directly. Geophysicists are well aware of these facts, but not so all members of the oil fraternity. I regret the necessity of being realistic but I repeat, it is quite safe to say that no new geophysical principles will be found among the war babies.

This may sound like pessimism, but I do not believe that accomplishments come in on a hope and a prayer. Geophysics made spectacular advances in the early days when principles old to science, but new to geophysics, were brought to bear on problems. We are not in a process of stagnation, but we should not delude ourselves that there is magic to be pulled out of a hat. Geophysics, as a science, is old enough to be beyond that stage and we must work harder for smaller gains, making use of new tools, new instrumentation borrowed from other fields, and this process is usually a slow one devoid of spectacular events.

Two Fundamental Principles

Where then is the solution? At this point it is pertinent to consider the problems presented and review briefly the methods thus far used, in order to gain a more rational viewpoint.

Orthodox geophysical methods operate on either of two fundamental principles:

1. Forces having their origin in subsurface anomalies are observed at the surface.

2. The subsurface is probed in such a manner as to permit mapping the attitude of certain discontinuities which are stratigraphic markers or related to such geologically significant markers.

In the first category, we have only two choices: gravitational effects produced by density contrasts or magnetic effects resulting from nonuniform magnetic properties. We have no other operating principle available. For using these effects we have the

two oldest tools of geophysics, the gravimetric and the magnetic methods. Both magnetic and gravimetric methods have been and will continue to be, useful as reconnaissance tools. Their effectiveness has been increased in recent years through more enlightened methods of interpretation, made possible through an increase in both the accuracy of the data and the amount of detail secured. Improved instrumentation has been responsible for both higher accuracy and lower operating costs.

How much further improvement may be expected in these reconnaissance tools? We have practical gravimeters, but they have already reached the point where the accuracy of observation exceeds the "noise level," which means that there is no substantial justification in striving for increased instrumental sensitivity. More detail will help the interpreter, but this can be accomplished best by improving the topographic survey methods so that the over-all costs of precision gravimetric observation can be reduced.

Reconnaissance Tools

The magnetic method has been in somewhat less favor than the gravimetric method as a reconnaissance tool, although with modern interpretation technique applied to field data of sufficient detail and accuracy, it has a definite usefulness. For various reasons it seems that the magnetometer has not kept pace with the gravimeter. While existing instruments are capable of precision within the "noise level," in general they are not so operated. However, it may be said that there are definitely on the horizon, improvements in magnetic instrumentation that can enhance the capabilities of the magnetometer. If demand justifies, such improvements will be made, but they will present an improved reconnaissance method, not a radically new oil-finding tool.

In the second category, whereby the subsurface is probed, energy is applied at the surface and propagated through the subsurface. Simple physical principles limit our choice to the use of wave energy, either electromagnetic or elastic in nature. Practical electromagnetic methods, because of the electrical properties of the subsurface, involve only very low frequencies, which for maximum penetrations, degenerate into essentially direct current phenomena. These methods comprise the already well known electrical prospecting methods which have been extensively exploited and are still the subject of extensive research. Greater success than in the past, may or may not attend the application of electrical methods in the future, but one thing may be said with confidence; radio-frequency phenomena will not be applicable to oil finding.

Elastic wave energy is the second, and to date the most useful method of probing the subsurface. From the surface it is possible to deduce the path followed by elastic waves from their source to the point of observation. We deal with somewhat hypothetical beams of sound as probes, and from a partial knowledge of the propagation velocities along complex refractive or reflective paths, we cal-

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A Sketch of the S.E.G. President

R. D. Wyckoff received his degrees as a bachelor of science and electrical engineer at Michigan State College in 1920. After a short period as mechanical engineer in the plant engineering department of the Ford Motor Co., 1½ years on the electrical engineering staff at Michigan State College, and 1 year in general electrical engineering work at Lansing, Mich., he joined the staff of the U. S. Bureau of Standards, electrical instrument section, remaining for a 3-year period.

In 1926 he entered the geophysical field with the Marland Oil Co. in Oklahoma, and in 1929 he joined the staff of the Gulf Research & Development Co., primarily to continue development of pendulum apparatus and later in charge of the physics division. During the latter period he was associated with the development of gravimeters and general production research. In 1936 he again entered the geophysics division and from 1936 through 1939 was district supervisor in the Gulf Research's Houston office. Since that time he has been a member of the geophysical research staff at Pittsburgh.

He is a Fellow in the American Physical Society, senior member of the Institute of Radio Engineers, member of the A.P.I., A.I.M.E., American Geophysical Union and the Society of Exploration Geophysicists. He was editor for the latter society from 1939 to 1942, and served as president in 1943-44.

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culate depths to the discontinuities responsible for these phenomena and attempt to map their configuration. This appears to be a more direct method than any of the others discussed, and in one sense it is. But the record includes such complexities introduced by intervening strata that precise interpretations are impossible; in fact, in practical operations, we are able to use only a part of the information that should be present on the record.

It is impossible to say when, if ever, such latent details as amplitudes, phase shifts, dilational as distinguished from longitudinal waves will have diagnostic significance, and can be used in adding detail to our present seismic maps. At the moment it appears that such details are stripped of all practical significance. We have no control over the transmitting media and hence, the additional details which theoretically should be contained in seismic records may forever be obscured, regardless of technical advances.

Direct Finder Is Remote

I have omitted mention of the geochemical methods, not because I am a confirmed disbeliever, but I am an agnostic, since it appears that several years of intensive research has provided no conclusive answer regarding their effectiveness. There is a theoretically sound basis for such methods, but only the future will tell to what extent it is amenable to practical application. The status of geochemistry will probably not change suddenly to one of assured success and our direct oil finder still seems some distance away.

In this review of the available geophysical principles, I have stressed the conclusion that we cannot rely upon any spectacular and revolutionizing improvements in any category to provide immediately the desired improvement in the oil-finding power of our instruments. But it is my firm conviction that the effectiveness of geophysical exploration can be substantially increased by application of more judicious handling of equipment, of the data obtained and the geophysical talent available.

The industry has developed an unfortunate attitude toward geophysical maps, particularly seismograph data, because it is presented in the familiar and tangible form of subsurface contours, and it assumed that with the completion of the map, the geophysicist's role has ended. On the basis of such a map considered as the unique and positive solution of the seismic data, an area is condemned, or drilled and too frequently abandoned on the basis of inadequate tests. Moreover, the geophysicist himself is condemned along with his equipment, with the result that he becomes more conservative and unwilling to speculate beyond the most positive data visible on his records.

The seismograph interpreter must piece together thousands of control points derived from elusive reflection events with possibilities of distortions and complex travel paths, and he is practically alone in his understanding of the problem. Under such conditions and the ever-present lash of criticism, he is forced into a conservative attitude. Yet the industry calls upon geophysics to find stratigraphic traps. Location of such traps by seismograph is not impossible, but it will be accomplished only by frank acceptance of the risks that face the interpreter.

I am aware of the practical considerations that cause nebulous or speculative prospects to be discarded, but if the seismograph is expected to find stratigraphic or even lithographic traps, not to mention oil itself, it is folly to assume that this goal can be attained without accepting greater risks than the industry is now willing to assume. To be realistic, if the industry wishes to find such traps, it must be prepared to accept and act upon seismograph data far less certain in character than has been acceptable in the past. This will call for a change in the general attitude towards geophysics and its coordination with the policy-forming and exploitation departments. I may as well be frank on this point.

Geophysics is spoken of as a "tool" for the geological department. But the seismograph is not a machine, which by turn of a crank, pours out maps to be read. Instead, a large part of its effectiveness depends upon the human factor, the acuity and experience of the geophysicist.

Geophysics is a scientific tool, but its practical application is as much an art as the practical applications of geology, and the personal factor will remain its most potent complement. An imaginative and venturesome geophysicist is as necessary as the instrument he uses, but the usual current administration of geophysics suppresses, rather than encourages such traits. Under such circumstances, the industry will continue to cry for technological advances not available, while its policies develop in the equally important human complement, the very antithesis of desired progress.

I am not one who believes that geophysics is stagnating through lack of technological advances, though I freely admit and even emphasize that I cannot see now any revolutionizing tools on the horizon. But as long as the industry is permitted to star gaze through the wrong end of the telescope, waiting for some magic out of the hat, geophysics will continue to be condemned unjustifiably for its inability to find the illusive oil reserves that are the hope of our domestic petroleum industry. It is the

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geophysicist's job to make this clear and to point the way whereby those tools now at hand may be made more effective, using the same course whereby geology and production engineering succeeded. That means that the geophysicist must have ready and regular access to the policy making and action formulating sanctums of the industry.

Prospective Oil Areas of South America

THE broader features of the geology of South America indicate fairly definitely those parts of the continent which show most promise of being oil productive.

The greatest extent of promising teritory lies in a belt bordering the eastern base of the Andes mountain system from Tierra del Fuego to the island of Trinidad. This sub-Andean belt is now productive in the Neuquen, Mendoza, and Salta regions of Argentina, in southern Bolivia, in Central Peru, and in Venezuela. Parts of the belt of Argentina are unfavorable, but otherwise, for the whole distance, sedimentary formations likely to produce oil underlie the belt and in many places have been folded sufficiently to produce structures favorable for trapping oil.

Though much of the sub-Andean belt is geologically favorable for the generation and accumulation of oil, the problems connected with its development are great. In much of the belt, except locally close along the mountain base, the prospective oil-bearing rocks lie at great depths, ranging up to 15,000 ft. or more, and the structures will be difficult to find owing to a thick mantle of comparatively recent gravels, sands, and silts, spread eastward from the growing Andes, unconformably burying the older rocks. In much of the area the search for oil must be by geophysical means.

On the eastern side of Patagonia, sinking in the late Cretaceous developed a sedimentary basin in which is located Argentina's most productive oil field at Comodoro Rivadavia. Farther south, in the Province of Santa Cruz, and extending south and east into Tierra del Fuego, is another somewhat similar sedimentary basin, not yet adequately tested, in which conditions seem promising and in which marine Tertiary as well as Cretaceous rocks are present.

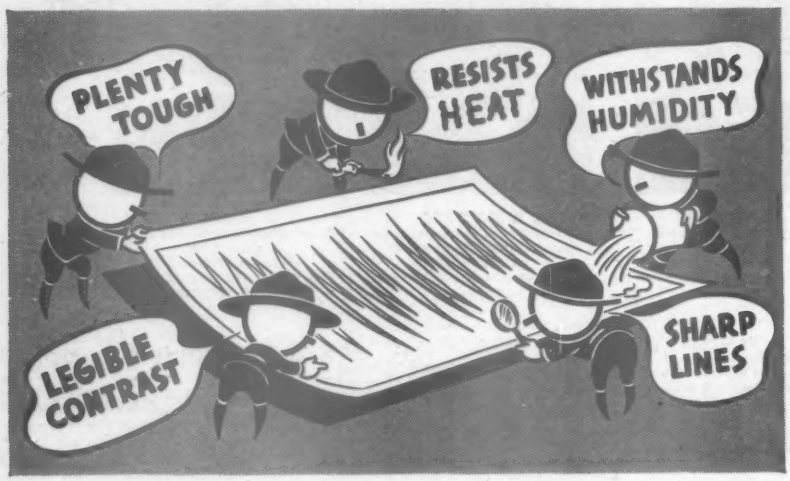
On the west coast of northern Peru and in western Ecuador, Tertiary subsidence and block faulting developed a thick series of marine sediments and suitable structural traps which have produced the important oil fields of that region. Further work may be expected to extend the fields already known and to uncover others under similar geological conditions.

In Colombia several troughs on the Caribbean slope offer promise. The upper Magdalena Valley is being explored, and the Cauca graben also seems to offer conditions promising enough to merit careful study.

In Brazil, oil has recently been found in a relatively small down-faulted basin of Cretaceous rocks near Salvador (Bahía). Large areas in East Central Brazil are covered with a relatively thin mantle of Paleozoic rocks in which, at places, oil showings have been found. One such area is a Paleozoic trough, probably of only moderate depth, holding Silurian, Devonian and Carboniferous rocks, through which the Amazon flows for about 500 miles in its lower course.

One of the largest areas of potential oil territory, not yet productive, is the huge Paraná Basin region of southwestern Brazil, Paraguay, and northern Uruguay.

This discussion of the regional geological features of South America was presented at the A.A.P.G. morning session March 1[illegible] by John L. Rich, University of Cincinnati.



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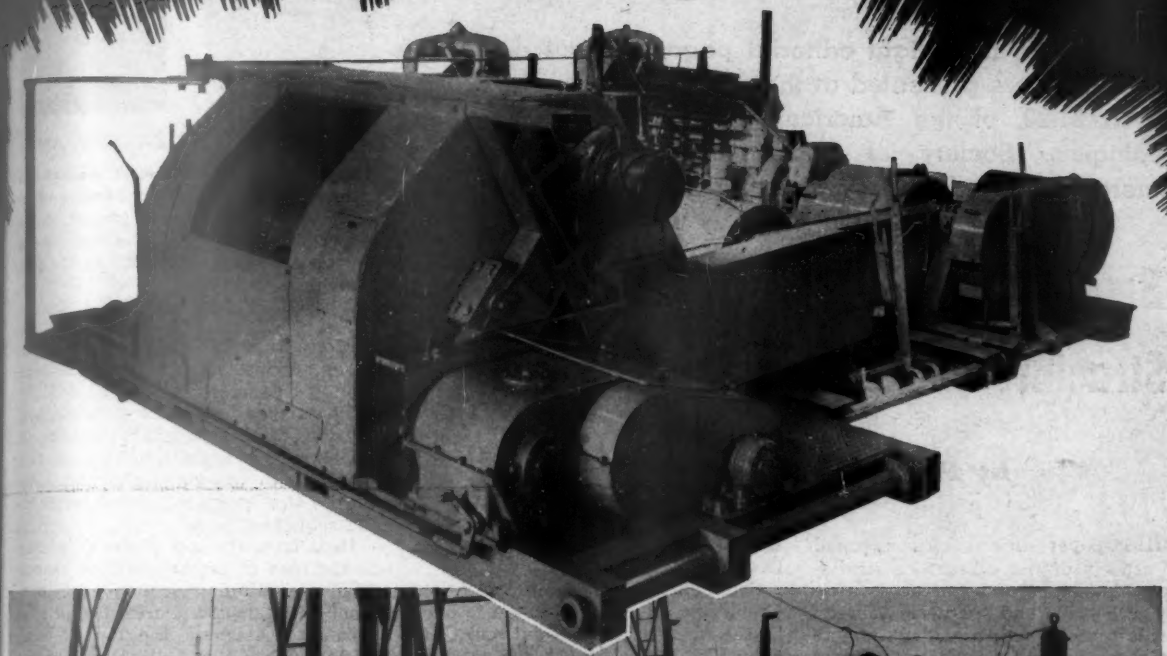

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A.A.P.G. Digests

This and the next eight editorial pages present digests of several papers presented at the annual meeting in Dallas, March 21-23, of the American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists and Society of Exploration of Geophysicists.

Regional, Subsurface Stratigraphy and Structure of Florida and South Georgia

P. L. APPLIN

ESTHER R. APPLIN

This study of the two most southeastern states is particularly timely because of recent exploratory attention focused on the region. Paul L. Applin is on the staff of the U.S.G.S. and Esther R. Applin is a consulting paleontologist.

by Paul and Esther Applin

THIS paper deals with regional aspects of the subsurface stratigraphy structure and micropaleontology of Florida and southern Georgia, and is presented as a contribution to the recently inaugurated program of oil and gas investigations by the U. S. Geological Survey.

Sediments from Recent to Lower Cretaceous in age are known to overlie the crystalline basement rocks, and older deeply buried beds are probably present between the Lower Cretaceous and basement rocks. The sedimentary cover is in excess of 11,500 ft. in the southern part of peninsular Florida. In this paper, the discussion of the subsurface-sedimentary section begins with the Oligocene and takes up the stratigraphic units in descending sequence.

Beds from the top of the Oligocene to the base of the late middle Eocene form a continuous sequence of limestone throughout the area, but in each formation between the top of early middle Eocene and the base of the

CORRELATION TABLE

SUBSURFACE BEDS FLORIDA AND SOUTHERN GEORGIA								
		LIMESTONE FACIES		KEY FOSSILS	CLASTIC FACIES	KEY FOSSILS	TEXAS	
OLIGOCENE		UNDIFFERENTIATED		ROTALIA BYRAMENSIS VAR.			OLIGOCENE SERIES	
EOCENE	UPPER	OCALA	UPPER	LEPIDOCYCLINA OCALANA EPONIDES JACKSONENSIS			JACKSON FORMATION	
			LOWER	AMPHISTEGINA CF CUBENSIS CAMERINA SP.				
	UPPER (?) OR LATE MIDDLE(?)	AVON PARK LS.		COSKINOLINA FLORIDANA LITUONELLA FLORIDANA			CLAIBORNE GROUP	YEGUA FORMATION: COCKFIELD OF SOME MICROPALEONTOLOGISTS (NONIONELLA COCKFIELDENSIS ZONE)
	LATE MIDDLE	TALLAHASSEE LS. AND EQUIV. NONFOSSILIFEROUS LS.						
	EARLY MIDDLE	LAKE CITY LS.		DICTYOCONUS AMERICANUS		POLYLEPIDINA GARDNERAE ASTEROCYCLINA MONTICELLENSIS		COOK MT FORMATION
	LOWER	OLDSMAR LS.		HELICOSTEGINA GYRALIS		DISCOCYCLINA BLANPIEDI	WILCOX GROUP	
PALEOCENE		CEDAR KEYS LS. (OF W. S. COLE)		BORELIS GUNTERI	UPPER MIDWAY AGE VELASCO-L. MIDWAY AGE	GLOBOROTALIA VELASCOENSIS	MIDWAY GROUP	WILLS POINT FORMATION KINCAID FORMATION
	TRANSITION	BEDS (?) 2 WELLS		N.E. FLORIDA & SO. PENINSULA				
UPPER CRETACEOUS		LAWSON LIMESTONE		LEPIDORBITOIDES SEVERAL SPECIES	NAVARRO AGE	VARIOUS TYPICAL SPECIES	NAVARRO GROUP	
		TAYLOR AGE		STENSIOINA AMERICANA ABDT INOCERAMUS FRAGMENTS	TAYLOR AGE	STENSIOINA AMERICANA ABDT INOCERAMUS FRAGMENTS	TAYLOR MARL	
		AUSTIN AGE		VARIOUS TYPICAL SPECIES	AUSTIN AGE	VARIOUS TYPICAL SPECIES	AUSTIN CHALK	
		PRESENT ?			TUSCALOOSA FORM.		EAGLE FORD SHALE WOODBINE SAND	
LOWER CRETACEOUS		UNDIFFERENTIATED		ALVEOLINELLIDAE	NODULAR LIMESTONE RED SHALE SANDSTONE		WASHITA GROUP FREDERICKSBURG GROUP TRINITY GROUP	

Stratigraphic sequence from Oligocene through Lower Cretaceous in Florida and Southeastern Georgia

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beds of Austin age (Upper Cretaceous), two sedimentary or depositional facies are recognized. On the one hand, a clastic facies, composed largely of sands and shales with some limestone and chalky marl, occupies West Florida and southern Georgia; it is similar in its broader aspects to sediments of the western Gulf Coast. On the other hand, over most of the peninsula, the sedimentary section is almost continuously limestone from the top of the Oligocene into the Lower Cretaceous. In northern Florida and the north quarter or north third of the peninsula these two facies grade into each other. In effect, the limestone of the peninsula encroaches upward over the clastic facies, spreading northward in successive stages, so that by the end of the early middle Eocene the limestone facies occupies all of the peninsula, northern Florida and southern Georgia.

In general, also, the microfaunas of the clastic facies in western Florida resemble those of the western Gulf Coast, whereas the microfaunas in the peninsula, from the top of the early middle Eocene to the top of the beds of Taylor age resemble those of Cuba, the West Indies, Mexico and Europe, with but few species present that are known in the other places in the United States. Beginning with the top of the beds of Taylor age in the peninsula, the more familiar Gulf Coast microfaunas again appear. Some mingling of faunas of the two facies has been noted in the early middle and lower Eocene, but none in the Paleocene or the upper part of the Upper Cretaceous. The fauna of the Lower Cretaceous limestone in southern Florida, again, resembles that of limestone of this age in Cuba and of limestone in southern Mexico, there designated as Middle Cretaceous.

The Tertiary stratigraphic units discussed include (1) Oligocene (undifferentiated); (2) upper Eocene, Ocala limestone; (3) upper (?) or late middle (?) Eocene, "Lituonella floridana zone," (Avon Park limestone); (4) late middle Eocene, Tallahassee limestone and equivalent nonfossiliferous zone; (5) early middle Eocene, "Dictyoconus americanus zone," (Lake City limestone) of the limestone facies and its equivalent "Polylepidina gardnerae zone" of the clastic facies; (6) lower Eocene, "Helicostegina gyralis zone" (Oldsmar limestone) of the limestone facies and its equivalent "Discocyclina blanpiedi zone" of the clastic facies; (7) Paleocene, "Borelis gunteri zone" (Cedar Keys limestone) of the limestone facies and its equivalent in the clastic facies whose fauna is identical with that of the Velasco (lower Midway) of Mexico.

At the top of the Upper Cretaceous, a typical Navarro fauna is recognized in the clastic facies in some wells and is equivalent to the "Lepidorbitoides zone" (Lawson limestone) of the limestone facies. Taylor and Austin faunas are recognized in both the clastic and limestone facies. The Tuscaloosa formation is the base of the Upper Cretaceous and appears to be chiefly Eagle Ford age. The sequence of coarse sand and red beds found below the Tuscaloosa in a well in Levy County, Florida, is correlated as Lower Cretaceous and may, in part at least, grade into the Lower Cretaceous limestone of the south half of the peninsula. Black shale of possible Paleozoic age has been encountered in one well in northeast Florida.

A series of paleogeographic maps show the known and probable underground extent of the units noted above, and illustrate the writers' interpretation of the extent and transition of the two lithologic and faunal facies. A correlation chart and two cross-sections show the correlation of the formations encountered in each facies.

The structure of the area, referred to the top of the Ocala limestone, indicates two roughly parallel northwest-trending upwarps in the north half of the peninsula, one through the Ocala uplift, and one along the East Coast. A northeasterly trending trough extends from the Tallahassee area of Florida across southern Georgia, in about the position of the "Suwannee Strait" of Dall, Schuchert and others.

Important diagnostic foraminiferal species from the several formations and facies are illustrated.

Critical Factors to Be Considered In Well Spacing

M. G. CHENEY

M. G. Cheney, president of Anzac Oil Corp., Coleman, Tex., has devoted much time over the past several years to studies of well-spacing problems. He has served on numerous A.A.P.G. committees concerned with reservoir control through spacing. In this contribution he introduces the importance of maintaining saturation around the well bore, developing the theory that operation in such a manner is a material aid to ultimate recovery. Cheney also serves on spacing committees functioning under auspices of A.I.M.E. and A.P.I.

ARBITRARY rules regarding well spacing are precluded because of the large number of interrelated variable factors involved. Except in those few areas where all else is sacrificed to free play and the "law of capture" still prevails, there is need for careful balancing of those factors which promise economies and maximum net return by means of relatively wide spacing against other factors which indicate possible gains through closer drilling.

The most fundamental factors are geologic, such as the probable character, thickness and depth of the reservoir; the character and amount of the reservoir fluids; their relative freedom of movement to the well, and the type and amount of natural energy available to induce such movement. It seems safe to assume that during the process of accumulation, the oil migrated and concentrated in the more connected, permeable parts

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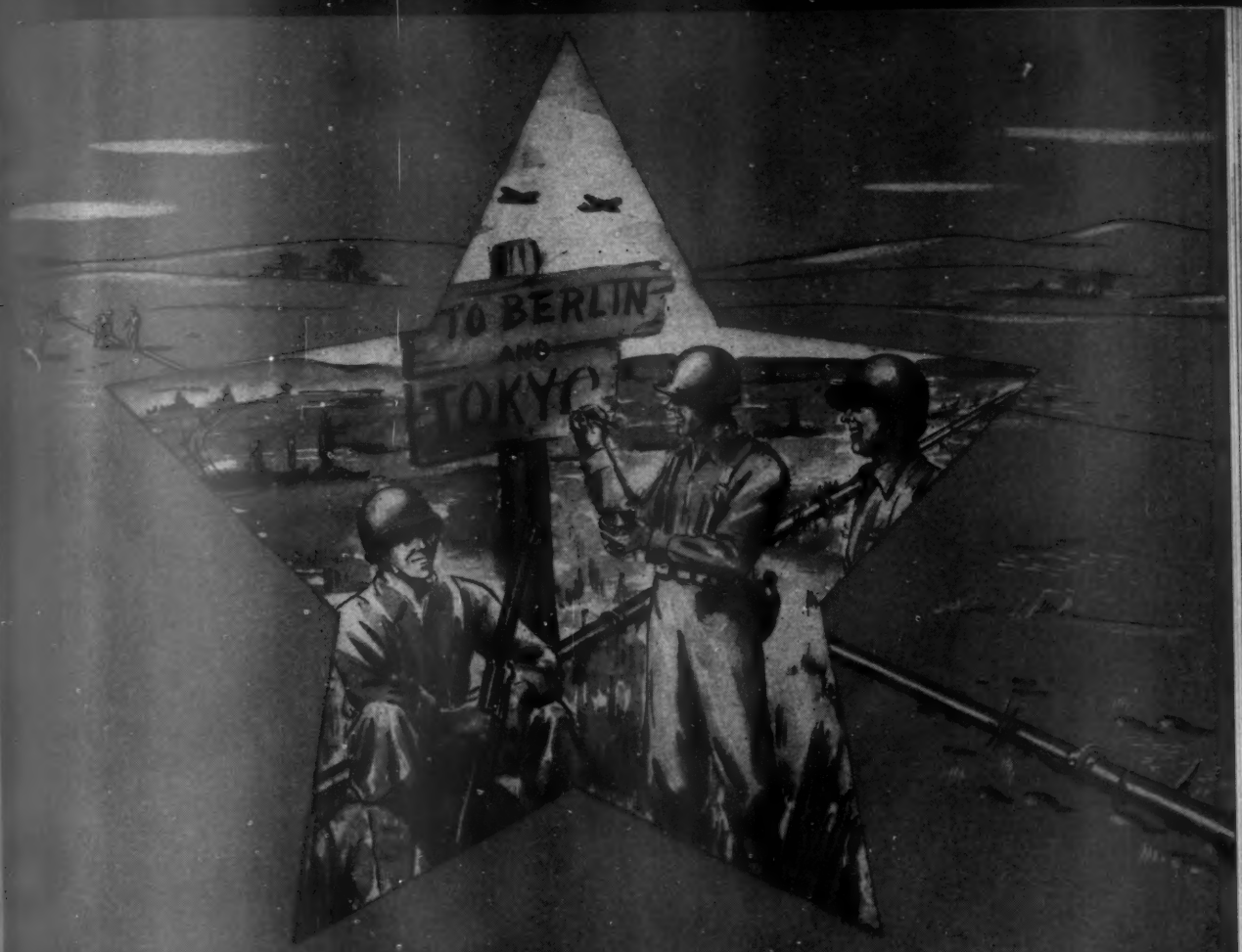

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of the reservoir rock. This basic condition favors the wide spacing of wells, except where subsequent excessive folding, faulting or cementation may have set up limitations on free-fluid movement.

Engineering Needs Arise Early

When production begins, other factors arise which call for strict engineering control, if high percentage recovery of the oil is to be achieved. Rate of production from the oil pool and from individual wells should be coordinated with the rate at which gas or water displace the oil through use of available energy, inherent in, or added to the reservoir fluids. Maintenance of a high degree of oil saturation around the producing well avoids serious loss of permeability to oil. This loss of permeability occurs at an accelerating rate as oil saturation decreases. Commonly, the maintenance of favorable producing conditions and effective differential pressures within the reservoir are much more essential to high recovery than is the close spacing of wells. Many closely drilled oil pools have been poorly drained. Examples of high recoveries per acre-foot from efficiently operated fields with relatively wide spacing are becoming increasingly numerous, recoveries being so high in some cases that any added wells would clearly be a waste of labor, capital and steel. Seemingly contrary evidence in the literature should be given close study. Geologists and engineers have a very great responsibility in interpreting the limitations imposed or permitted by the various geologic, engineering and economic factors related to optimum spacing of wells. Legal regulations should give due regard to these criteria.

Two articles in the February 1944 issue of the A.A.P.G. Bulletin illustrate how wide a divergence of opinion may exist as to the influence of well spacing on oil recovery.

Elliott discusses the Jones sand production of the Schuler field, Arkansas, which was produced from 1938 to February 1941, under moderate restriction. This was followed by 3 years of pressure maintenance and careful engineering management. Production versus reservoir pressure decline data for the first 3-year period forecast an ultimate yield of 34 million barrels from 20-acre spacing as against 54 million barrels from 60 acres per producing well under pressure-maintenance methods. Recoveries have now passed the 30-million-barrel mark. Reservoir pressures remain above 1,400 lb. per sq. in. as compared with 1,640 lb. 3 years ago. Gas-oil ratios have remained well below the ratios which prevailed late in the first 3-year period and, for the past 2 years, have been held substantially below the trend indicated during the first year of pressure-maintenance operations.

In the second article, Clark, Tomlinson and Royds present "a study of the effect of well spacing on recoveries based on factual data from 10 different fields." According to their analysis, recovery efficiency from five Mexia-Powell fault-line fields as well as from five important fields of Oklahoma and Kansas depends largely upon the density of wells. The evidence presented appears quite conclusive until factors other than spacing are considered. For example the basic data for the Woodbine sand fields of the Mexia-Powell trend is open to doubt.

The comparatively low acre-foot yields of the Mexia (fault leases) is based on 56.9-ft. thickness whereas electrical logs indicate more nearly 40 ft. Average porosity of 28 per cent, connate water content of 10 per cent of pore space, and 10 per cent oil shrinkage are assumed for all five fields, although much less favorable figures than these must be used for the Woodbine sand of the East Texas field where more complete data are available. It is probable that the original recoverable oil content for any of the 10 fields reviewed did not exceed 1,250 bbl. per acre-foot. Yields above this figure for portions of the fault-line fields, as well as in the Oklahoma City field, may be interpreted as reflecting the ease of movement of these light oils within the reservoir and the advantage which accrued to early drilling with accompanying high production rates functioning during periods of high pressure, the gain being proportionate to the number of wells completed during this favorable early period. Also, drilling is commonly concentrated where sand and structural conditions are most favorable.

The importance of maintaining as high a degree of oil saturation as possible is demonstrated by laboratory experiments and in many cases by well performances. Under open flow, a condition which prevailed in at least 6 of the 10 fields referred to above, cones of gas from above or of water from below may develop, thereby reducing the oil saturation near the well. Obstruction to oil movement must increase according to differences in the viscosity of the competing fluids, gas, water and oil (named in the order of increasing viscosity). Heavier oils as in the Healdton field are doubtless coned off more effectively than the lighter oils of the other fields. No doubt the fluid movement becomes more and more selective according to the extent of drying out from excess flow of gas or to the degree of wetting by advancing water.

Resaturation With Oil

Wells which have gone to a high gas-oil ratio under open flow have been restored to normal gas-oil ratios by injection of sufficient oil to resaturate the reservoir around the well. In some gas-drive fields where wells under more open flow have practically ceased to produce oil, wells on adjoining leases have continued as good flowing oil wells. The latter wells have been allowed to flow for short intervals at a time, being shut in as soon as gas "breaks through" the oil. By this method high oil saturation can be maintained near the well and bubble resistance, loss of reservoir pressure, and increase in viscosity of the oil can be retarded.

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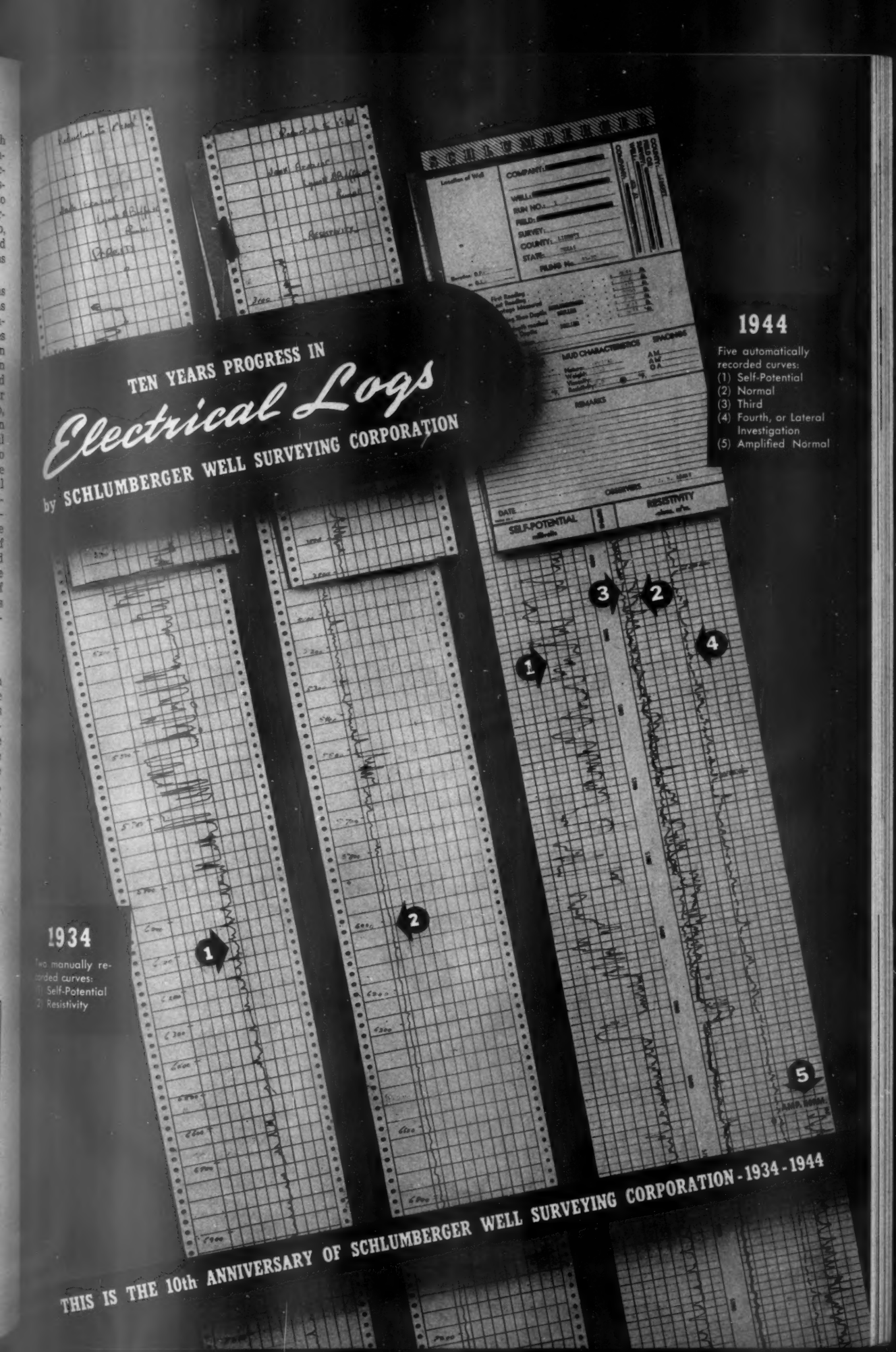
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cent lead to excessive high water-oil ratios.

Maintenance of favorable producing conditions where interference between wells has been avoided by wide spacing of wells, has resulted in high acre-foot yields for surprisingly large areas around such wells. Such performances merit special study by those interested in conservation and increased operating efficiency. Careful study of the physical factors and of the operating methods most suited to the circumstances are essential to the determination of the optimum spacing of wells for each oil pool.

Petroleum Reservoir Efficiency And Well Spacing

STUART E. BUCKLEY

IN 1939, Standard Oil Co. (New Jersey) affiliated companies and the Humble Oil & Refining Co. began a cooperative program of study to determine the effects of field operating practices and well spacing on the efficiency of oil recovery. The Jersey group and the Humble company each created a "Committee on Reservoir Development and Operation" with provision for exchange of data and discussion of findings as developed. (See The Oil and Gas Journal, January 13, page 35).

Each of the committees reviewed all available theory and research information and against this background studied the field data on reservoir behavior and oil recovery under various well spacing and operating practices in some 20 fields or producing areas. Included in the study were fields in South America as well as in the United States, representing all types of conditions and operating practices and well spacing patterns ranging from 2.4 to 180 acres per well. The results of these studies and the conclusions derived from them

Stuart E. Buckley, acting head of the production research department, Humble Oil & Refining Co., has been engaged primarily in that phase of operations since 1933. He first entered the oil industry in 1933 as a roustabout for the Humble company in the Conroe (Texas) field. He was appointed to his present position in April 1942. Buckley was born at Eagle Pass, Maverick County, Texas, in 1908. He graduated from the University of Texas with bachelor of science and master of science degrees in chemical engineering. He is a member of Tau Beta Pi and Sigma Xi, honorary societies, and of the A.P.I., A.I.M.E. and A.C.S.

have been made available to the industry in the form of a booklet entitled "Petroleum Reservoir Efficiency and Well Spacing."

The speaker reviewed and explained the conclusions of these committees and presented some of the information in support of their conclusions. The findings of these committees may be summarized as follows:

1. Various oil recovery mechanisms, differing in their characteristics and in their efficiency, have been recognized.

2. Within the range of spacing likely to be encountered in practice, distance between wells has, in itself, negligible effect on ultimate oil recovery. Proper location of wells is considered to be more important than the number of wells.

It was found that the ultimate recovery from any field is influenced to a marked degree by the type of drive operative. In so far as the type of drive is subject to control, the ultimate oil recovery may be effected by operating practices. However, in no field studied by the committees was there apparent any physical relationship between well spacing and recovery from the reservoir as a whole.

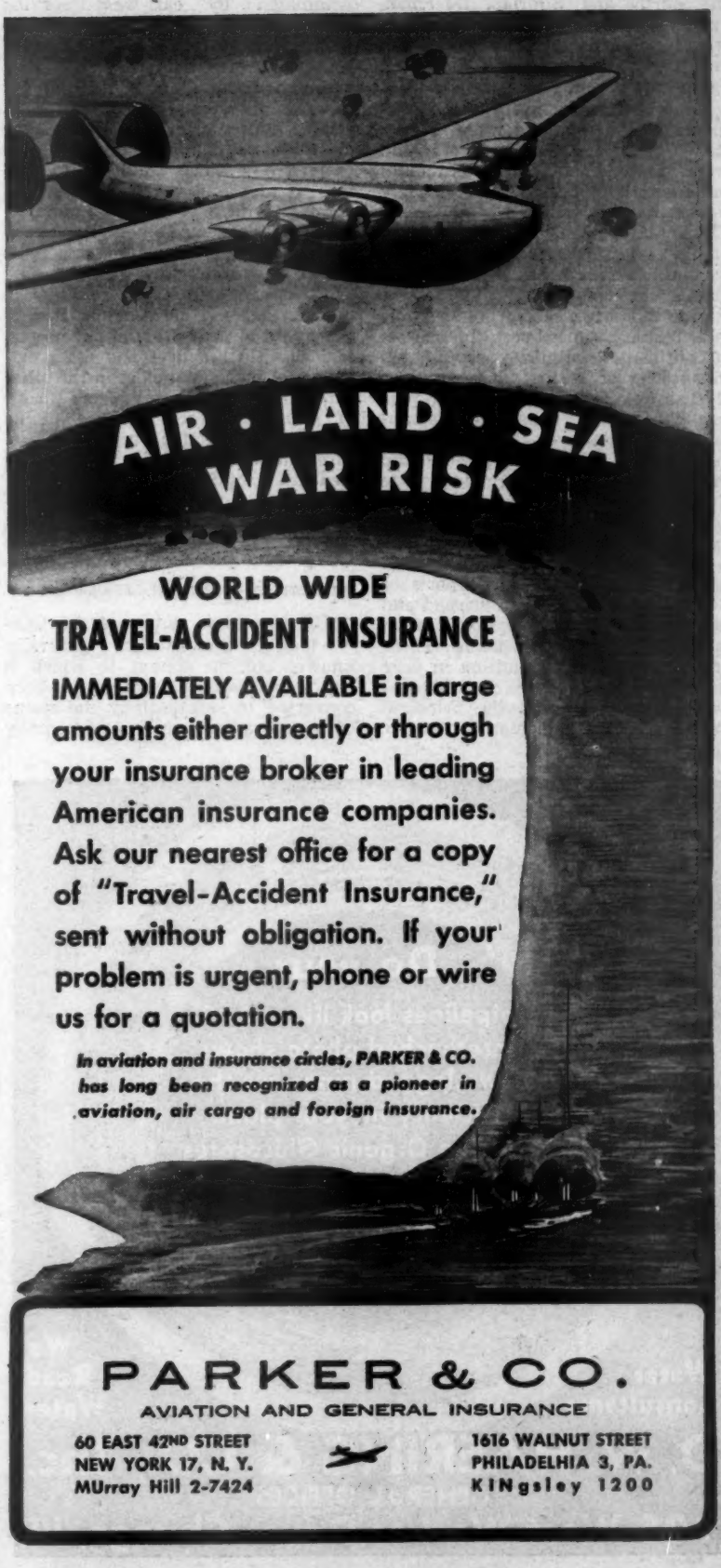
Outline of Chinese Geology

I. MARVIN WELLER

THE structural framework of greater China consists of three positive areas and three geosynclines that separate and enclose them, similar in general arrangement to comparable structural elements in eastern North America.

In late pre-Cambrian time and during the Paleozoic era, a thick succession of dominantly marine formations accumulated in a great trough extending northeast-southwest across China proper. At the end of the Ordovician

Dr. J. Marvin Weller of the Illinois State Geological Survey is geologist and head of the stratigraphy and paleontology section of that organization with which he has been connected since 1925. He is a graduate of the University of Chicago. From 1920 to 1922 he was engaged in geological work in northwestern India in the employ of the Whitehall Petroleum Corp. of London, and in 1937 and 1938 he led a geological exploring expedition into northwestern China and northeastern Tibet. Dr. Weller has crossed China from east to west and from north to south and in the course of more than 10,000 miles of travel in that country has visited 10 of its 18 provinces.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period, this trough was restricted on the north, and Silurian, Devonian, and Mississippian strata are absent from North China. The Pennsylvanian and early Permian seas, however, again extended into that region.

Important mountain-forming movements occurred at intervals toward the close of the Paleozoic era, and from mid-Permian time continental sedimentation became increasingly important, particularly in North China and Central Asia. At the end of the Triassic period, eastern Asia was uplifted and has never subsequently been subjected to important marine submergence. During Mesozoic and Tertiary times, vast thicknesses of continental sediments accumulated in a series of basins whose outlines shifted as the result of diastrophic movements that raised new mountains, particularly at the ends of the Jurassic and Cretaceous periods and in middle or late Tertiary time. Late Cretaceous disturbances were especially important and were accompanied by extensive volcanism.

A late Tertiary peneplane is well preserved throughout large parts of Central Asia. It has been warped and faulted and is obviously older than many of the mountain chains. These have been raised by faulting in very recent time, and there is abundant evidence that some of the principal mountains are still rising.

The structure of Central Asia is dominated by east-west curving mountain arcs, but the coastal region is characterized by northeast-southwest trending structures. Throughout most of China proper these two systems have produced a complicated interference pattern. The diastrophism that affected Central and eastern Asia since the Paleozoic era was so profound that most parts of China are intensely folded and faulted. Five large sedimentary basins with moderate or gentle structures exist, however, two in Chinese Turkistan, one in Tibet, and two in western and northern China. Two of them are practically unknown geologically but seepages and other evidences of petroleum exist in the other three. The one that appears to be of greatest interest because of its stratigraphic section, type of structure, and accessibility, is the so-called Red Basin of Szechuan Province.

Wartime Duties of U.S.G.S. Cover Multiple Services

WILLIAM E. WRATHER, director U.S.G.S.

THE peacetime duties of the Geological Survey are generally known, but the extent to which it has "gone to war" is not. It has been converted to substantially the status of a war agency and is principally engaged in (a) investigations of strategic and critical minerals, including petroleum, (b) reports on foreign areas, (c) reports on water supplies, (d) classification and mineral development of public lands, (e) topographic and photogrammetric mapping.

Since 1938, all the mineral work of the survey has been on a war basis. In 1939 a direct appropriation of $150,000 permitted the organization of commodity groups, composed of geologists who devoted their time to one or another of the 14 minerals or metals designated as "strategic" or "critical" by the Army and Navy. Today there are 53 minerals and metals so designated.

Commodity Geological Groups

The commodity groups, each headed by a commodity geologist, range in size from one or two geologists to as many as 35 men, depending upon the field to be covered and the urgency of the wartime demand. This latter factor is constantly changing and the personnel of the groups is not rigidly fixed.

In 1940 a field of foreign activity was opened through the State Department and the committee for cooperation with the American republics. Geologists from the various commodity groups were sent to South and Central American countries to examine known and potential mineral deposits.

By 1943 it had become apparent that petroleum had become one of the critical minerals. Within recent months the survey has embarked upon a program which it is hoped will aid the petroleum industry in its search for new deposits.

The purposes of the oil and gas investigations that are being undertaken differ in no degree from those which have guided similar work by the survey during past years. The work is regional in character and involves study of the surface and subsurface stratigraphy of large areas. The studies will be devoted primarily to the accumulation of data for the preparation of maps and stratigraphic sections showing such features as (a) the thickness of oil-producing formations, (b) changes in facies or porosity of oil formations or possible oil formations, (c) margins of producing or possible producing zones, and (d) the relations and extent of lenticular sands. The studies will have as their objective the delimitation of broad areas that are favorable for exploration. Determination of local structural features will not be stressed.

The work is being undertaken in California, the Rocky Mountain, Mid-Continent, Gulf Coastal Plain and the Appalachian regions. It has been carefully planned with the active collaboration of many representatives of the oil and gas industry and of public organizations, such as the state geo-

logical surveys. Representatives of the American Association of Petroleum Geologists have been particularly helpful.

In order to make the results available at the earliest possible time, photolithographic copies of preliminary maps, structure sections, and stratigraphic diagrams accompanied by brief mimeographic texts will be made available within a month or two after the completion of the copy.

The Radioactivity and Organic Content of Some Paleozoic Shales

ROLAND F. BEERS

BY measurement of the total beta activity, the total alpha activity and the radium content, a new method has been developed for the routine determination of radioactive substances in sedimentary rocks. The important radioactive elements in these rocks are uranium, thorium and potassium. Earlier work by Beers and Goodman has shown that these radioactive elements may be found largely in four principal loci: (1) In association with the heavy minerals of sands and sandstones, (2) in K^{40}, the active isotope of potassium which is found in evaporites, oil-field brines, clastic fragments of micas and other potassium-bearing minerals, and in clays and shales which may contain up to 6.5 per cent potassium, (3) in the uranium and thorium content of shales and clays, impure limestones and marls, shaly sandstones and organic sediments; (4) in sediments which have had as their source rocks the residuum of the weathering of parent rocks, whose debris was once concentrated on surfaces of unconformity and contained high concentrations of radioactive substances in some instances.

Roland F. Beers received the degree of electrical engineer in 1921 from Rensselaer Polytechnic Institute, Troy, N. Y. For 1 year he was instructor in physics and electrical engineering at the institute, and then joined Western Electric Co., New York City. In 1925 he became research engineer for the Raytheon Co., and in 1927 was appointed physicist for the Submarine Signal Corp., Boston. In 1928 he received the degree of S.M. in electrical engineering from Massachusetts Institute of Technology, and joined the Geophysical Research Corp. in Houston, Tex. He was made vice president of that company in 1934. In 1936 he organized The Geotechnical Corp., of which he is now president. In 1940 he initiated graduate studies at Harvard University and M.I.T. in the field of geology, and was awarded the degree of Ph.D. in May 1943. He is the author of several papers pertaining to the reflection seismograph and holds a number of patents in this field.

Pure limestones and pure quartz sands are found to exhibit practically no measurable radioactivity. Black shales containing up to 16 per cent organic matter have been found to contain high concentrations of the three principal radioactive elements. Excellent correlations are shown to exist between the uranium content, the thorium-uranium ratio and carbon content in individual shale formations.

These studies throw new light on three important problems: (1) The sedimentation environment of Paleozoic black shales, (2) the evolution of petroleum source beds, (3) quantitative determination of radioactive elements which may comprise one of the origins of petroleum.

A New Type of Seismic Cross-Section Wherein Accuracy of Representation is Rendered Insensitive to Velocity Error

PHIL P. GABY, Geophysical Service, Inc.

A FUNDAMENTAL variable utilized in seismograph computations is reflection arrival time. In order to convert from time to depth a velocity function must be used. The accumulation of well velocity data during recent years has demonstrated the importance of lateral variations in velocity and the resultant fact that velocities obtained from the shooting of any well cannot be assumed valid over large areas. Since velocities have been observed only at scattered locations, interpolation or extrapolation must be used in selecting the velocity function to be used at all other locations. By this means it is possible to employ a sliding scale of velocities for making seismic computations, which is a complex undertaking rendered rather hopeless by the almost certain knowledge that velocity information, subsequently obtained, will indicate inaccuracies despite initial painstaking care. Hence a certain amount of recomputation is almost inevitable whenever additional velocity information is obtained.

The prime problem is one of finding a means whereby computations may be carried to an advanced stage in such manner as to be insensitive to velocity error. If this be done, then recomputation can begin at that advanced position to save considerable time and effort. The use of time-sections and time maps represents one solution of this problem because the velocity function does not enter until the finel step in computations. But this solution usually involves the assumption that horizontal offset of the reflecting point is zero—an assumption which may lead to confusing results in areas of deep or sharp folding, or in faulted areas. This is illustrated by example.

Most other computation procedures involve the adoption of some assumed velocity function prior to representation. Inaccuracy of such representation is extremely sensitive to error in assumed velocity function. Subsequent recomputation must begin at the point where the velocity function was first used and a very large amount of work is frequently involved.

By means of the proposed system, representation of seismic data, both on the cross-section and the resultant time-map, is rendered insensitive to errors in assumed velocity function. An accurate contour map can be drawn for any seismic horizon to show vertical travel time from the reference plane. One can then quickly derive contours in datum values through use of any sort of velocity field currently believed to be most accurate. Subsequent recomputations may begin at this advanced point to save considerable effort and time.

The concept is presented of a section wherein the horizontal coordinate is horizontal distance and the vertical coordinate is vertical travel time. A cross-section in such space utilizes a velocity function to determine the horizontal offset of each reflecting point and the computed vertical time from reflecting point to reference plane. Dip indications are expressed in vertical time increment per unit of horizontal distance; correlations are similarly indicated.

A practical method of plotting data in these coordinates is presented and discussed. Advantages believed peculiar to the system are tabulated.

A Geophysical Survey of Kuwait, Persian Gulf

PAUL H. BOOTS, Gulf Research & Development Co.

THE problem of finding oil in some of the more promising sedimentary basins in the Near East may be roughly analogous to going into the Gulf Coast, California, or Oklahoma in 1890 with modern geophysical equipment to look for the fields that were undiscovered at that time. This paper qualitatively describes a geophysical survey that was made in Kuwait in 1936-37. Kuwait is a country covering about 12,250 square kilometers between Iraq and Saudi Arabia at the head of the Persian Gulf. Prior to the geophysical survey, there was but very scant geological information on the country. A field party, equipped for magnetometer, gravimeter and seismograph exploration, entered Kuwait in September 1936. The magnetometer and gravimeter

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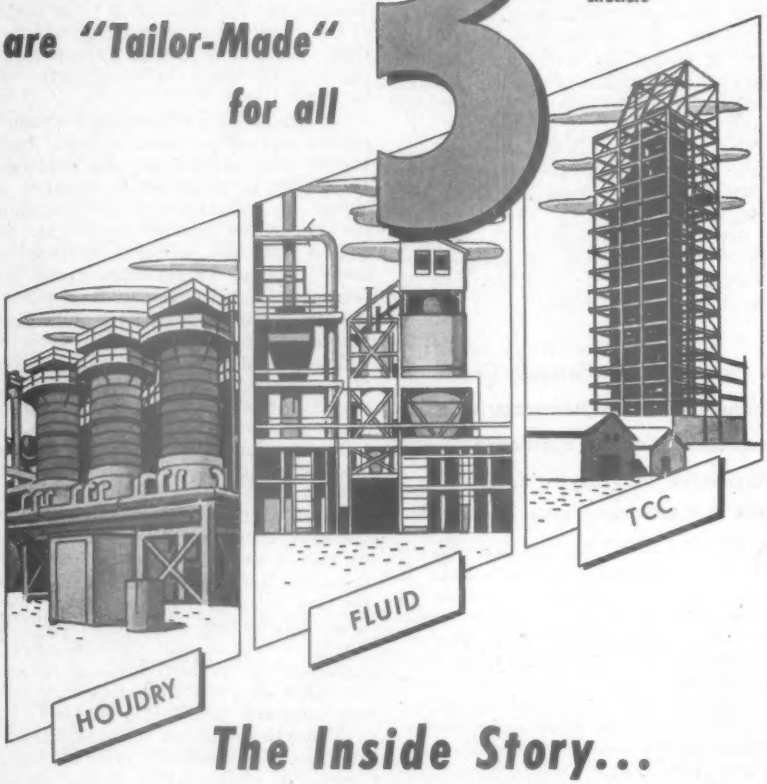

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were used as reconnaissance instruments and quickly pointed the way to an anomaly which was investigated by the seismograph. The entire country was eventually covered by a gravity survey. The magnetic survey was carried far enough to judge its worth relative to a gravity survey. The seismograph survey guided by the results of the magnetic and gravity work was carried far enough to outline a structure which was later drilled and proved to be a new, large oil field. The party was withdrawn from Kuwait in May 1937.

This paper tells in some detail of the organization of this combined geophysical operation and the philosophy behind the use of the tools in the way each was used. Further, the problems of working in the Near East are outlined together with a discussion of how the survey would be done with the use of the hindsight gained by experience. Probably other areas of the Near East would lend themselves equally well to an attack by a well organized geophysical party. Economy of operation is obtained by the use of a party that is equipped and staffed to do almost any kind of work and to adjust its methods to the conditions found. Also, the geophysical methods supplement one another, so that no time is lost in this type of operation in taking advantage of leads furnished by one of the geophysical tools available.

The Correlation Refraction Method of Seismic Surveying

J. A. GILLIN, R. D. ARNETT, E. D. ALCOCK, National Geophysical Co.

IT is not uncommon in seismic surveying to encounter areas in which the reflection method fails to produce results. These areas present a problem and a challenge to the geophysicist. Most of the uncomplicated areas have been surveyed one or more times with the seismograph, while these problem-areas represent virgin territory for exploration, and as such, warrant the expenditure of considerable time and effort in their solution.

The causes for the failure of the reflection method are many, such as surface conditions, discontinuities in the subsurface, lateral changes in velocities, etc. Due to the diversity of conditions which can cause the failure of the reflection method, each problem area must be considered as an individual case and analyzed from the standpoint of those conditions which are thought to cause the failure of the standard reflection method. In some cases the problem can be solved by some variation in the standard reflection technique, while in other cases it is necessary to abandon the use of reflections and resort to refraction technique.

An outstanding example of an area, the major portion of which to the

present time has proved unsuitable for the standard reflection method or any variation thereof, is the Edwards Plateau in West Texas. This statement does not imply that some portions of the plateau cannot be surveyed by reflections. At the present time it is thought that the main cause for the failure of the reflection method in this area is the presence on the surface of a thick section of hard lime (Edwards lime). It is known that in those parts of the plateau where the lime section is thin or absent entirely, and to the south of the plateau where the lime is buried by a blanket of younger sediments, it is possible to use successfully the reflection method.

One method which has been developed to solve the problem of obtaining subsurface seismic data on the Edwards Plateau has been called the Correlation Refraction Method. This method is based upon the interpretation of the recorded arrivals of energy traveling from the shot point to instruments along refracted paths. The interpretation is not necessarily confined to one horizon, since the recordings are made in such a manner as to register not only the first arrival of refracted energy but all subsequent arrivals as well.

This paper gives a description of the fundamental theory on which the method is based and a description of field technique.

Subsurface Correlation by Detailed Electrolog Tabulation

M. M. KORNFELD, Midstates Oil Corp.

AHITHERTO undescribed method of subsurface correlation by detailed electrical well log tabulation and comparison. Procedure involves the indispensable use of a light table to permit superimposition of curve for curve for any two electrologs studied. With the usual skeletonal control of known stratigraphic markers or paleontological data for orientation, further correlations proceed independently, sole reliance being placed upon close inspection and comparison of similar electrolog curves.

Care is taken to insure accuracy of any one correlation by the use of multiple control points to substantiate individual comparisons. Electrolog curves are matched with extreme precision. Only most obvious correlations are recorded in early stages, proceeding always from known to unknown, leap-frogging all obscure correlation zones until complete positive correlations are established. Thereupon, each zone of obscure or disturbed section is studied in detail, further correlations made if possible, and points of departure from normal bracketed on the electrolog involved.

Differences between correlation points are not calculated until all comparative depths are completed and tabulated thereby insuring unprejudiced correlations free from influence of other comparisons above or below. Once information is tabulated and ready for study further dependence upon the electrolog strips is removed except to check possible errors in reading the electrolog or to examine special portions of the electrologs for details of departure from normal.

Information is assembled in as many as six vertical columns consisting 1, markers and electric curves employed; 2 and 3, the correlative depths of any two wells studied; 4 and 5, the differences between correlation points in 2 and 3, actual and subsea; and 6, the departures from normal, recorded as gain or loss as revealed by columns 4 or 5.

Detailed comparative studies with electrologs as outlined provide a degree of precision to quantitatively prepared tabulated data which reduces to simplest terms the elements of subsurface changes for geologic interpretation.

Above quantitative method is recommended for substitution of graphic methods, eliminating previous necessity to alphabetize and color electrolog sections. Electrologs are thereby preserved as factual rather than interpretative evidence of well history. Moreover, it is possible to qualitatively portray changes in subsurface conditions by use of graphical analysis based upon electrolog quantitative correlations.

Discrepancies in scale or distortion of electrologs due to lack of uniformity in printing are minimized or eliminated by quantitative tabulation. Errors in distortion cannot be made as pin-point correlations are made horizontally rather than vertically, isopach calculations being made from recorder tabulations instead of from the electrolog strips.

The light table should preferably be of the cold light or fluorescent type as correlative work is continuous for long periods of time. Incandescent or hot light is obviously unsatisfactory, except for short intervals. The extension of the use of the light table from map to correlation work should make the light table an indispensable tool in subsurface work.

Effect of Ray Curvature Upon Seismic Interpretations

E. J. STULKEN, Geophysical Service, Inc.

WITH theory of seismic paths well established and with errors due to neglect of ray curvature considered in general terms or isolated examples in previous papers, there remains a need for extended calculations measuring the effect of curvature.

For specific velocity functions inaccuracies of velocity computations, based on straight path assumptions, are illustrated graphically as variables dependent on spread and depth. Discrepancies traceable to use of straight line methods of depth determination are likewise described. In addition, dip and offset computations are considered for cases of dipping reflectors. The significance of these relations is related to the method used in determining velocity.

Application of common analytical expressions for velocity to orthodox curved path computations fails to guarantee accurate results in some instances. Errors introduced by neglecting pertinent irregularities in observed data, for the sake of employing a simple velocity equation, may outweigh the gain in accuracy attributed to the rigorous method. It is indicated by example that existence of sloping "isovelocity" surfaces may invalidate the usual curved path procedure; strict adaptation to needs of particular areas may be awkward, considering the ease and degree of accuracy with which vertical travel time approximations can be applied.

Estimating Ore Masses in Gravity Prospecting

SIGMUND HAMMER, Gulf Research & Development Co.

THE technical literature in the field of applied geophysics has treated quite extensively the interpretation of gravitational surveys in terms of probable size and depth of subsurface geological structures associated with observed gravity anomalies. These interpretative factors usually constitute complete evaluation of the data as far as objectives in prospecting for petroleum and some other geological applications are concerned. On the other hand, in prospecting for ore another interpretative factor is of great interest, namely the mass of the ore body indicated by the data. This aspect of interpretation has received scant attention in the technical literature of applied geophysics, especially in the field of gravitational prospecting.

It is well known that the interpretation of gravitational (and magnetic) data in terms of structure is not unique and that geological considerations must be invoked to select the most probable interpretation out of the infinitely many which are theoretically possible. On the other hand, mathematical physicists, at least, know that there is no lack of uniqueness, in principle, in the determination of the magnitude of the mass anomaly from the observed gravity anomaly, for the anomalous mass is determined by the surface integral of the product of area and relief of the gravity anomaly which it causes.

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Pipe Still Processes More Than Ten Million Barrels in Single Run

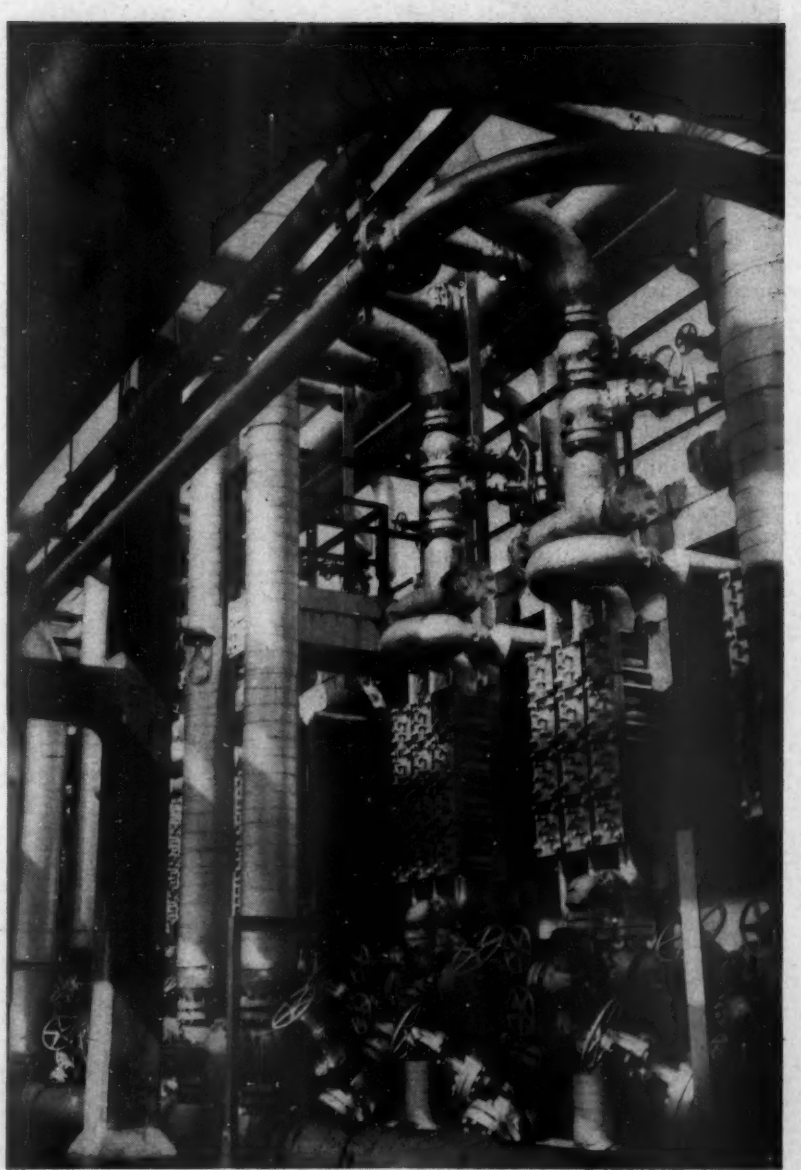
by John P. O'Donnell

Advanced design features and skill on the part of the personnel share equally in the credit for the remarkable record of this unit.

RECENT completion of a 6,366-hour run by a crude pipe still at the Bayway, N. J., refinery established a new record for the refining department of Standard Oil Co. of New Jersey and, possibly, for the industry. The extended run began May 16, 1943, and ended February 6, 1944, a period of almost 9 months during which 10,285,561 bbl. of oil were charged to the unit, an average of 38,813 bbl. per day.

One of the factors contributing to this record of continuous operation is the design of the unit which is unusual in several respects. The process was designed by Standard Oil Development Co., while the engineering design and construction was done by Arthur G. McKee & Co. However, department heads at Bayway give much of the credit for this unusual performance to the operators who took particular pride in the record run and have exercised especial care in operating the unit.

Unusual design features include: (1) Introduction of intermediate reflux systems. Without appreciable loss in fractionation, these systems lowered the heat load in the upper section of the tower thereby enabling a reduction in the size of that section and provided preheat at a higher temperature for the incoming crude.



Header on high-velocity, tubeflo exchangers. Note the double valve installation used on all hot-oil lines

Looking down on battery of heat exchangers serving No. 3 pipe still

(2) Use of flash drums ahead of the furnace. Corrosive wet vapors are disengaged at the drums and returned to the charge stream near the furnace outlet, thereby bypassing subsequent exchangers and most of the furnace tubes. (3) Combining the side-stream strippers into one column. This reduced both construction costs and heat requirements.

This pipe still is one of two identical units which were installed at Bayway in 1941 and started up in August of that year. They are shown together below with Still 3 which made the record run on the right and Still 2 which recently passed the 4,900-hour mark and may be on its way to a new record on the left. They are served by a common elevator, possibly the first time that such equipment was installed to serve a crude unit.

No. 3 pipe still was designed to run 28,000 bbl. per day of East Texas crude to 20 per cent bottoms or 32,000 bbl. per day of West Texas crude to 30 per cent bottoms. The charge to the unit during this 265-day period consisted roughly of twice as much sweet crude as sour so that its average, 38,813 bbl., was more than 30 per cent above design rating.

Together the two stills have run as much as 80,000 bbl. in a single day. The magnitude of this volume can be appreciated by comparison with the capacity of the big-inch line, 300,000 bbl. per day. This twin unit, therefore, is capable of processing more than 25 per cent of all the crude that is run through the line.

The types and quantities of stock run to No. 3 still during its record run are given in the following table:

Type—	Barrels
Sweet crude	6,009,338
Mixed crude	535,093
Naphtha distillate	187,010
Jusepin crude	61,440
San Joaquin crude	205,085
P. C. aviation base	22,382
Refugio crude	202,556
Sour crude	3,062,677
Total charge	10,285,561

Typical cuts made from crude in the unit were: Light naphtha for aviation gasoline, heavy naphtha for thermal cracking to produce butylenes for polymerization or alkylation for aviation gasoline blending stock, refined oil or kerosene, diesel 208 for Army service, a paraffin distillate for wax and light engine oils and residual bottoms usable as blending stock for Navy fuel oil.

Flash Drums Ahead of Furnace

One of the distinctive features of these pipe stills is the use of flash drums ahead of the furnace. The crude enters the flash drums after picking up heat from the refined oil in one exchanger and from intermediate reflux streams in two exchangers. On the crude side of these exchangers, the pressure is carried sufficiently high to prevent water vaporization and resulting salt deposition. The drums were installed to provide a method for flashing off the corrosive moisture-containing vapors at a point in the system where no salt deposi-

Over-all view of pipe stills No. 3, right, and No. 2, left. No. 3 recently completed a 6,366-hour run during which it processed 10,285,561 bbl. of oil

tion can occur. The pressure reduction effected in the drums vaporizes the water and light ends bypass remaining exchangers and are reintroduced into the charge stream six tubes ahead of the furnace outlet. As a result, the wet corrosive fraction of the charge is excluded from the remaining preheat exchangers and all but the last of the furnace tubes and the dehydrated flashed crude only passes through the high-temperature exchangers and furnace with the result that "frying out" of salt on tube surfaces is prevented.

After passing through the flash drums, the charge picks up additional heat from the paraffin distillate, diesel oil, cracking-coil tar brought in from an outside source and reduced crude streams. Exchangers imparting the highest preheat temperature are the tubeflo type which are used because of their ease of cleaning on both streams. The furnace is double-end fired and is capable of using either gas or oil. Preheated crude enters it through the convection section. The last tubes before the coil outlet are paralleled.

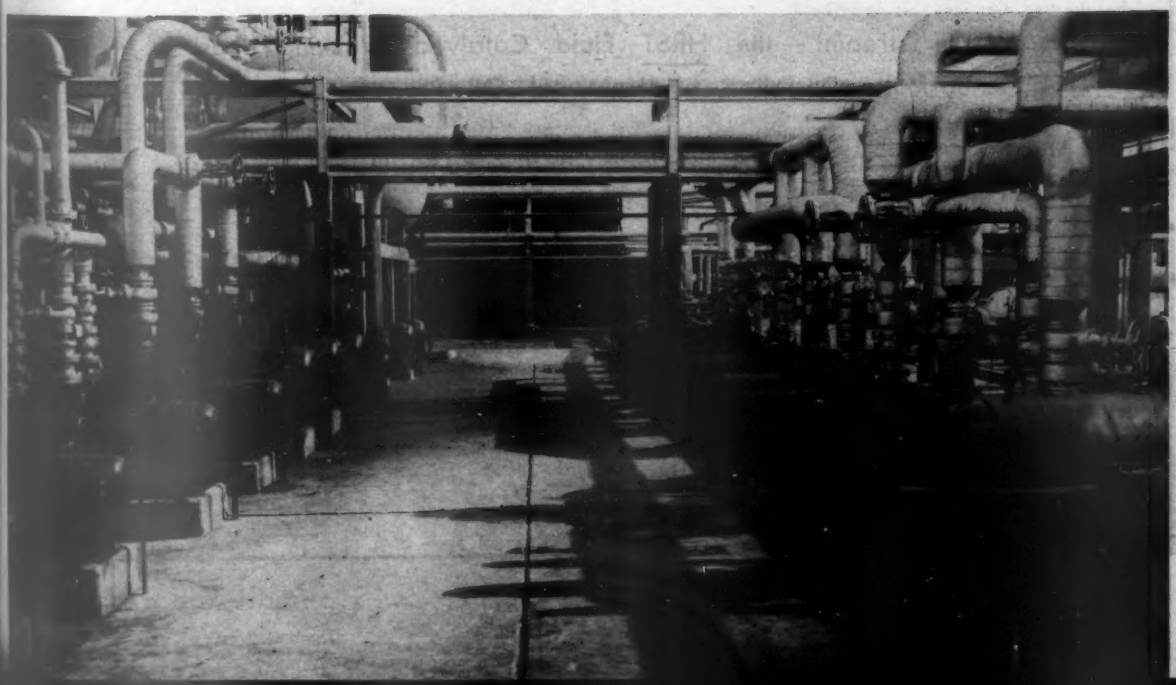
The fractionating tower is another unusual feature due to its dimensions. The 125-ft. column is divided into three sections; an upper section which is 12 ft. 6 in. in diameter; a middle section, 16 ft. 6 in. in diameter, and the bottom or stripping section, 5 ft. 6 in. in diameter. The heights of these sections, respectively, are 50 ft. 5½ in.; 60 ft. 9¾ in., and 13 ft. 10 in. It will be noted that there is a considerable reduction in the diameter of the upper section which, normally, is as large and sometimes larger than the middle section.

This reduction in the size of the upper section results in lower construction costs and contributes to the improved heat economy of the unit. A lower heat load is carried in the upper section due to the use of a large intermediate reflux stream in the top of the middle section. This stream reduces the vapor load above it sufficiently that a smaller size tower section can be used.

Streams May Be Interchanged

The side-stream reflux circuit at the top of the middle section immediately below the kerosene drawoff constitutes the largest of three pumparound systems designed to decrease the heat duty on the overhead condensers and to provide maximum heat for preheating the crude. A second intermediate reflux or pumparound system located below the heavy naphtha drawoff serves the upper section of the tower. The two are connected so that, if desired, the streams may be interchanged. The final pumparound stream is below the diesel oil drawoff and consists in pumping back cooled stripped diesel oil. The reflux stream would not normally be stripped but in this case it was desirable in order to use one pump for both product and reflux. The heat withdrawn by the three pumparound streams is used to preheat the charge and, because of their higher temperatures, is better suited for this purpose than overhead vapors.

Still another unusual feature of this unit is the combining of the side-stream steam stripers in a single column. All of the four strippers, heavy naphtha, kerosene, diesel oil and par-



Right, above: Double-end-fired furnace, capable of using oil and gas as fuel, on crude pipe still. Below: Pump assembly on record-breaking crude pipe still. All are electrically operated

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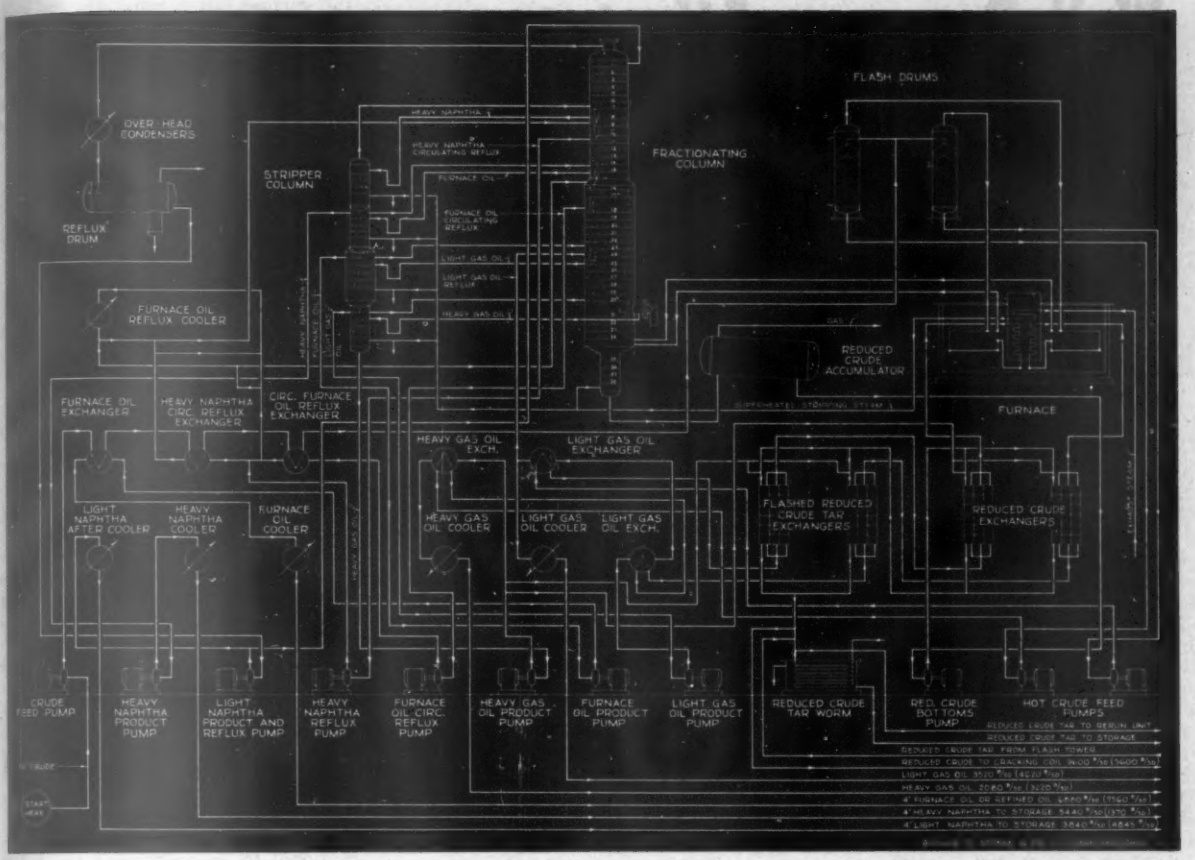

Flow diagram of No. 3 pipe still. (Diagram shows design figures for capacities, which were exceeded in production)

affin distillate are contained in one column. This also contributes to lower heat requirements and lower construction costs. In this arrangement the bottom of a higher stripper serves as the top of the next lower one. Each stripper contains four bell-cap plates.

The fractionating tower and other equipment were designed to handle sour crude. The upper part of the carbon steel tower is lined down to the third of the top trays with ⅛-in. monel and the bottom, including the stripping section, from the nineteenth tray down, is lined with 5/64 in. of KA2S alloy. The same type of alloy is used for all the trays and for the furnace tubes. The tower contains 37 plates distributed as follows: 15 in the upper section, 18 in the middle section and 4 in the stripping section.

Operation of the unit may be visualized from the accompanying flow chart. The incoming charge receives the initial preheat in the exchanger from the stripped refined oil. It then passes through two other exchangers where it picks up additional heat from the upper and middle section pumparound systems before entering two flash drums in parallel. The point of reentry of the vapors disengaged in the drums is shown just ahead of the furnace outlet.

The stream from the first flash drum then is further preheated by the stripped paraffin distillate, diesel oil, flashed tar, and reduced crude streams. The second flash drum stream is similarly treated except that it does not exchange with the paraffin distillate. The charge streams then enter the furnace through the convection section and are heated to the final temperature before fractionation.

The overhead from the tower consists of light naphtha suitable for use as aviation gasoline base. After passing through a cooler and condenser, for the removal of light ends, part is returned to the tower as reflux with the remainder going to storage. The first side stream, heavy naphtha, is taken off at the seventh plate and stripped before use as thermal reforming charge. The stripper overhead is returned to the tower. Because of the comparatively low temperature of these streams, neither is used for heating.

First of the two pumparound streams is drawn off at the tenth plate and, after imparting preheat to the crude, reenters the tower at the eighth plate. Kerosene is drawn off at the fifteenth plate with the product providing the initial preheat to the charge. The second pumparound system, drawn off from the pay below the seventeenth plate, provides the third source of heat for the crude before it is cooled and returned to the tower at the sixteenth plate.

The diesel oil drawoff is located at the twenty-third plate. After being cooled in exchange with the inincoming crude, reflux is returned to the next lower plate. The paraffin distillate is removed at the twenty-ninth plate and, after stripping, provides heat for the liquid stream from one of the flash drums. The tower bottoms, usable as heavy fuel blending stock, pass through an accumulator, before furnishing the final preheat for oil entering the furnace.

Nos. 2 and 3 pipe stills at Bayway were the first units of this design. Their operation has been so satisfactory that similar stills have been installed at two of the company's other refineries, Baltimore and Baton Rouge. At the time of the shutdown, No. 3 was processing as much crude as at any time during the extended run. The shutdown was caused by a flange leak in the steam line. Inspection showed that in spite of the long on-stream period, virtually no damage had been done to the oil system. The unit has been refired and is back to normal operations producing essential war products.

Well Pressure Affects Workover Procedure

by Harry F. Simons

Successful reconditioning of a well by reverse circulation is dependent upon several factors. Among these are possible loss of fluid to the formation, selection of the time for the job, and the bottom-hole pressure of the well. The effect of these factors upon the job are discussed in this article.

THE amount of fluid, particularly oil, a hole will take becomes of interest when a reconditioning job for a particular well is under consideration. This is not so much because of the loss of oil into the hole as it is the cost of getting the oil to the well site. Actually, in most instances, the oil lost in a hole during a reconditioning job is recovered through swabbing before the job is considered complete, so it isn't lost. Getting a required amount of fluid to do the work often entails considerable expense which could rob the project of its profit.

Loss of fluid to the formation is always of interest in a cleaning-out job by the rotary method with either normal or reverse circulation and it occasionally becomes of interest when working on a well with cable tools. Frequently, this factor will control the choice of method to be used and procedure to be followed. If return of the fluid to the surface cannot be obtained, the rotary method cannot be used, or the effectiveness and efficiency of the method is reduced. The rate at which the well takes fluid can be determined by actual test and it can often be estimated from the history of the well.

Estimating Fluid Loss

The production and bottom-hole-pressure histories of the well give a good indication of the amount of oil which will be lost to the formation per day under the conditions at the time the work is performed. If the well produced 300 bbl. per day at a differential of 300 lb. per sq. in. it is reasonable to expect that losses to the formation will approach that amount after the well has been cleaned and shot and a similar pressure is acting in the opposite direction, i.e., from the well to the sand. Generally, the rate at which the formation takes fluid at any differential pressure is also an indication of the rate at which oil will come into the well once the conditions are reversed.

The selection of the time to do the reconditioning job becomes important particularly if reverse circulation is to be the method used. If at all possible, the work should be done before the well ceases to flow as the loss of oil into the formation and the over-all cost will be less. Once the well ceases to flow and is put on the pump, the work can be done only under difficulty. This does not indicate that a pumping well with a reasonably high fluid level cannot be worked over by reverse circulation but that the costs will be greater and the results achieved somewhat less than when the work is performed on a flowing well.

Bottom-Hole Pressure

Sometimes it has been found that wells cannot be worked over when theoretically the bottom-hole pressure is high enough to permit such work. In other instances successful jobs have been performed on wells when the pressure apparently was insufficient. However, the theoretical pressure at which work can be done is one of the main factors in evaluating a project. It also provides some indication of the procedure to be used.

The bottom-hole pressure must not only support the column of fluid to the surface but it must also be great enough to permit the addition of the force required to lift the fluid through the tubing with sufficient velocity to carry the cuttings. The pressure drop in the tubing can be computed by the formula:

$$P = \frac{0.000108\ flrv^2}{d}$$

Where

p = pressure drop (lb. per sq. in.) = 96.12 lb. per sq. in.

l = length of tubing (ft.) = 1,000 ft.

v = velocity (ft./sec.) = 12 ft. per sec.

d = diameter of tubing (ft.) = 0.1666 ft.

r = density of mud (lb. per cu ft.) =51.50 lb. per cu. ft.

f = friction factor = 0.02

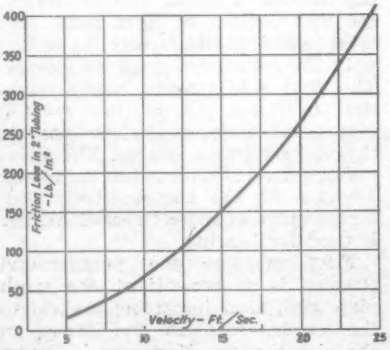

Fig. 1: Chart showing loss in pressure in 2-in. tubing with changes in velocity of fluid stream

The friction loss in the annulus can be ignored as it does not affect the excess pressure at the bottom of the hole required to lift the fluid to the surface but the friction loss in the tubing is a pressure which must be supported by the pressure in the formation. For a 4,000-ft. well the pressure loss in 2-in. tubing and surface connections is slightly over 400 lb. per sq. in. at 12-ft. per second velocity. A slight reduction in the velocity of the fluid stream has a consideration effect on the pressure loss as it is proportional to the square of the velocity. Thus, a velocity of 10 ft. per second in the above formula would produce a pressure loss of approximately 280 lb. per sq. in. in tubing and surface connections. It is therefore necessary to have a lower velocity in the tubing when working on wells with insufficient bottom-hole pressure. Rough tubing would cause an increase in the friction factor and a greater pressure loss.

Use of Other Fluids

There is also an upper limit on the well pressure suitable for reverse circulation work and it is the safe working pressure of the well-head equipment. Practically, this limit amounts to a well-load pressure of 1,200 to 1,500 lb. per sq. in.

Quite frequently fluids other than oil will be used in reverse-circulating work for a circulating medium and sometimes when oil is used there will be occasional temporary uses of water due to pressure conditions. The well may have a tendency to flow while a connection is being made, but this can be stopped by using normal circulation so a fairly "dead" oil is in the tubing or by pumping water into the tubing to increase the head there. If the well has reached the final completion stage and the pressure is too great to safely pull the tubing to remove the bit, the bit is left on the tubing and the well hooked up.

Oil-Well Pumping Practices—No. 31

Methods of Torque Analysis In Central-Power Operation

Even distribution of torques on a central pumping power is essential to smooth operation and effective handling of loads. Factors and conditions relating to analysis of these torques are outlined in this installment. Previously, counterbalancing effects, loads and distribution of loads have been discussed. Forces directly causing torque are of primary consideration.

by J. Zaba

THE three previously discussed methods of analysis of load conditions of a central pumping power considered the counterbalance effect, the loads, and the manner of distribution of these loads. Steps leading toward analysis of torques are outlined in the discussion of the following two methods of analysis. For this type of analysis dynamometer cards on wells operated by the power must be available.

Analysis of Central Power Balance Method 4

All forces acting on a power resolve themselves into two components. The one vertical to the crank causes the torque on the power, the torque equaling the vertical component times the crank throw. The other component acting along the arm of the crank tends to overturn the power. Of the two components the one causing the torque is of primary importance since even distribution of torques is a condition on which the satisfactory and smooth operation of the central power is based. The other component, representing direct pull on the power along the rod lines, is usually not considered in an ordinary analysis. It is being generally assumed that power itself and the foundation have been designed in such a manner as to take care of the ordinarily expected overload conditions resulting from the component acting along the arm of the crank.

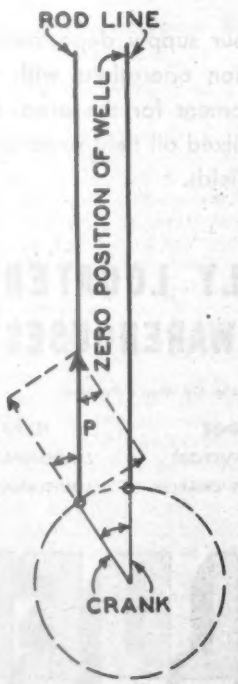

Fig. 1: Torque on crank of a central power

The first method of analysis of torques uses as starting point, the consideration of loads of individual wells.[1] In case of a central pumping power the ratio of length of "power pitman," that is of the rod line, to the crank is so large that for all practical purposes, the well load acting on the power at any position of the crank can be considered as acting parallel to the load of the zero position of the crank, when the well is at the beginning of the upstroke. If this is true, then the load component vertical to any instantaneous position of the crank equals the load times sine of the angle between given position of the crank and the zero position of the well (Fig. 1). Based on this premise, the method uses following procedure for arriving at final results:

The directions of wells from the central pumping power are plotted and one of the wells is arbitrarily assumed as zero position. (Fig. 2). The angles are then measured counterclockwise, between the zero position and other wells. Table is then prepared showing the angle, for all the wells and for different positions of the crank, between crank and well-load directions. The crank positions are usually considered in 30° intervals. To illustrate preparation of the table using example shown in Fig. 2: For crank position 0° the angle between crank and direction of well No. 1 is 0°, the angle between crank and direction of well No. 2 is 25°, the angle between crank and direction of well No. 3 is 45°, etc. After the crank moves, counterclockwise, to 30° position, the angle between the crank and direction of well No. 1 is 330°, the angle between crank and direction of well No. 2 is 355°, the angle between crank and direction of well No. 3 is 15°, etc. These calculations are carried through for all wells for all positions of the crank at 30° intervals.

The next step is to determine from dynamometer cards, the loads for each well for different positions of the polished rod. This is being accomplished by procedure outlined in Installment 29 of the series, that is by drawing the circle on the zero line of the card and by projecting the 30° divisions of the circumference of the circle to the load curve of the card.

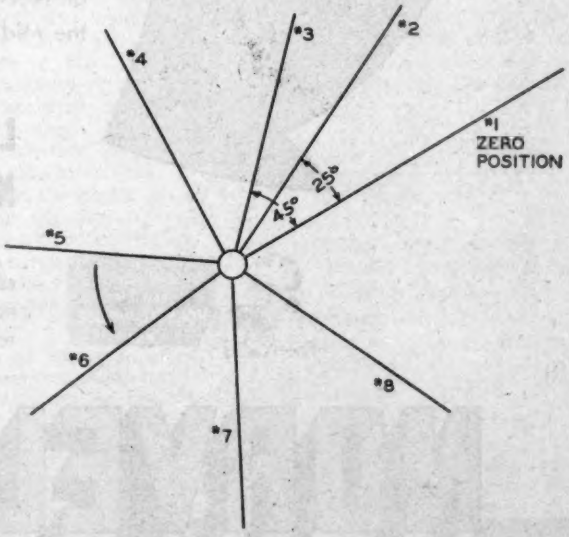

Fig. 2: Plot of wells operated by a power

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After the loads have been thus determined use is made of the original premise of the method that the component vertical to any position of the crank equals the load times size of the angle between given position of the crank and zero position of the well. Table is prepared showing, for each well and for each crank position, first the load as determined from dynamometer cards, second the angle between crank and well direction shown in Fig. 1, third the product of each load and sine of the corresponding angle. This product equals the torque load. Differentiation must be made between positive and negative torque load for the upstroke and downstroke phases of the cycle of each well. The algebraic sum of the torque loads of all the wells for each position of the crank equals the torque load on the power for each position of the crank.

The most convenient way of presenting this torque load for further analysis is to plot the torque load curve on the polar coordinate paper. Inspection of such a diagram will suggest the size and direction of rod-line counterbalance which has to be added to the installation to correct unsatisfactory torque distribution, if the chart shows that such conditions exist. The torque caused by the counterbalance is then calculated for different positions of the crank and added, algebraically, to the previously calculated torque load. The new torque load curve including the counterbalance torque is then plotted to determine whether or not the assumed counterbalance fulfills satisfactorily its purpose.

Analysis of Central Power Balance Method 5

This method arrives at torque conditions of a central pumping power by determining the loads of all wells for each of the 12 positions of the crank and determining, graphically, for each position of the crank, the resultant load, and its component vertical to the position of the crank. The method offers a very convenient way of correlating the loads on each rod line for any position of the crank.[3]

The dynamometer load curves for each well are transferred on polar coordinates charts. The loads for different positions of the polished rod, preferably for 10° intervals, are determined from dynamometer cards, in a manner previously mentioned and illustrated in more detail in Installment 29. The loads are then plotted against angle of rotation with zero position assumed as beginning of the upstroke. Fig. 3 shows a polar diagram of a dynamometer load curve.

The rod lines are then plotted in the usual manner and the angles between rod lines are determined, each of the eccentrics being treated separately. One of the rod lines is assumed in zero position and the load for this well, for zero position, that is the beginning of the upstroke, is read from the polar diagram. For the same crank position the polished rod of the next well is ahead or behind the polished rod of the first well, depending on direction of rotation, by the angle which equals the angle between the rod lines of the two wells. The corresponding load of the next and other wells can be, therefore, read directly from their respective polar diagrams. After the crank moves 30° to its new position, polished rods of all the wells move through 30° of their cycle and the well loads are again determined for these new positions from the wells' polar diagrams. In considering the loads on the other eccentric it should be realized that, for the purpose of reading the loads on the polar charts, the angle between any rod line on this eccentric and zero rod line on the first eccentric equals the angle between the two rod lines plus 180°.

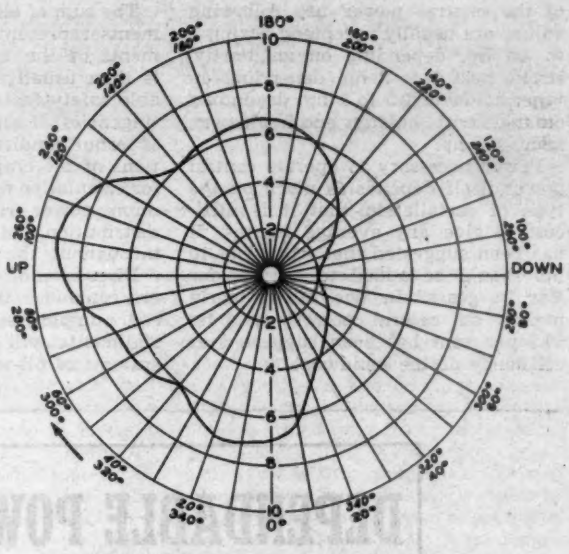

Fig. 3: Polar diagram of a well-load curve

The loads are read in this manner for all wells for each of the 12 positions of the crank and the data are tabulated. Vector polygon of forces is then constructed for each position of the crank (Installment 30) and the resultant load determined. The resultant for each crank position is then resolved into two components, one vertical and one parallel to the arm, the vertical component representing the torque load. The magnitudes of the components are read and tabulated. Components in the direction of rotation are denoted as plus, those opposed to rotation as minus. The torque loads are then plotted against the angle of rotation of the crank to obtain the torque load curve. The resultant torque on the power is determined by adding, algebraically, the torque loads of the two eccentrics. Inspection of the curve suggests whether or not additional counterbalance is needed to improve the existing torque conditions.

The five methods of analysis of load conditions of a central pumping power, presented in this and in preceding installments of the series, cover the subject quite sufficiently although still other methods are available and are being used. The problem of keeping central pumping powers in proper balance is of sufficient importance to warrant close attention to the subject. For this reason more than one method of approach to the problem has been presented.

On a central power operated by an electric motor the conditions of balance can be checked by measurements of the power input during the cycle. In case of powers operated by engines accurate determination of balance conditions is difficult without use of some kind of theoretical analysis of loads.

Power Requirements

In selecting the prime mover for a central-pumping-power installation power requirements of individual wells are added. This total is increased by power necessary to overcome friction of rod lines and rod-line auxiliary equipment and internal friction of the central power plant itself.

Friction of rod lines has been discussed in Installments 25 and 26 of the series. To convert friction load to friction horsepower formula can be used:

$$HP_F = \frac{C \times L \times W \times SPM \times ST}{33{,}000 \times 12}$$

where

C = rod-line coefficient of friction, 0.2 to 0.6, depending on conditions

L = length of rod lines, feet

W = weight per foot of rod lines, pounds

SPM = strokes per minute

ST = rod-line stroke, inches

Power required to operate the jack is negligible. Power for different types of rod-line auxiliary equipment depends on the type of construction of the equipment. In one of the areas

of the central power use following values are usually accepted:[3] Swing 1 to 1.5 hp. depending on angularity, stroke post 1 to 2 hp. depending on type, holdover 0.5 to 1 hp. depending on angularity, holdups and holddowns about 0.5 hp.

Power necessary to operate central power itself depends so much on the type of installation that it is difficult to give any average figures. It has been suggested that from 5 to 10 hp. should be added to account for loss in gears.[4] In one of the early papers on central power pumping 60.7 per cent has been suggested as efficiency of the bandwheel.[5]

The sum of all these power requirements represents the power requirements of the installation. This total is then usually increased by a suitable safety factor to provide for contingencies. If analysis has been made of torque conditions for different positions of the crank, data are available for calculation of maximum and minimum power requirements, and for distribution of the requirements throughout the cycle.[6]

Discussion of central pumping powers concludes the subject of sucker-rod pumping systems. Following installments will consider the rodless systems of oil-well pumping.

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GEOLOGIC FORMATIONS AND ECONOMIC DEVELOPMENT OF THE OIL AND GAS FIELDS OF CALIFORNIA. Prepared under the direction of Olaf P. Jenkins. Published by State of California Department of Natural Resources, Division of Mines. 773 pages.

The theme of Bulletin 18, the above volume, is geology. In all, 126 geologists have contributed articles for the bulletin, each on a subject well known to him. Maps, sections, charts and pictures have been used freely to augment the text. All published rock names are briefly defined and accompanied by selected citations in a glossary of geologic units. The bulletin has been indexed thoroughly. Accompanying the volume is an economic state map, showing the locations of the oil and gas fields and other drilled areas.

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20 YEARS' PROGRESS IN COMMERCIAL VEHICLES. By Athel F. Denham. Distributed by Military Vehicles Division, Automotive Council for War Production, Washington, D. C. 247 pp.

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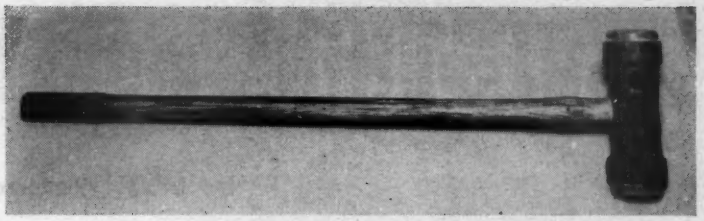
PLANT PRACTICES



Shaping Press Made From Obsolete Punch Press and Die Sets

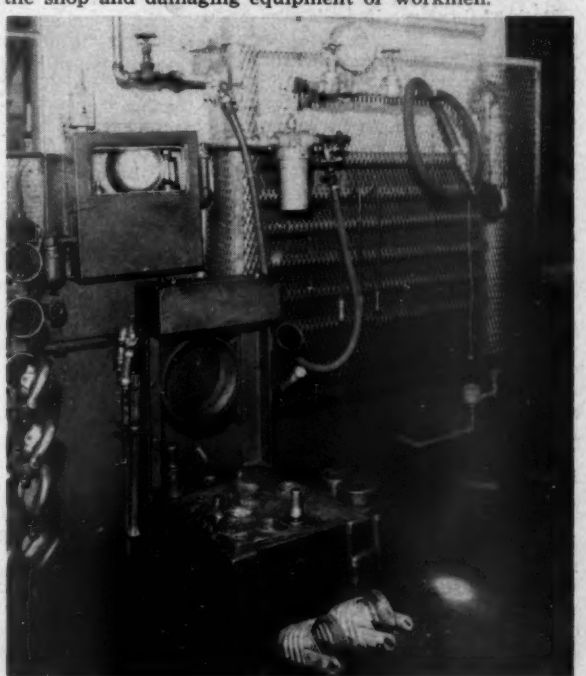
AN old punch press, superseded by more modern equipment, was converted to a shaping press, merely by the addition of different shapes and arrangements of dies. One die set is made up of a ¾-in. sheet-steel strip about 24-in. long fitted to the press plunger by bolts passing through the slotted plunger head, the edge of this blade being beveled on each side to give a ¼-in. edge. A V-trough die is fitted to the press base so that the edge of the beveled blade comes down directly into the apex of the V-trough. The V is right-angled and sheet metal may be placed over this V to be bent in the required shapes as the operator desires. To use the press as a pipe straightener, dies are used as follows: The base die is a heavy steel sheet, to which is fitted two heavy steel blocks cut with V-notches in the same plan. A steel sheet to which is welded a single V-block is bolted to the press plunger in such position that this V-block is directly above and exactly midway between the two V-blocks on the base die. The pipe, rod, etc., may be placed in the base V-blocks and the upper V brought down at the center of the bend and force applied, changing the position of the piece until it is straightened. In the case of pipes or rods of a single size, the V-notches may be replaced with semicircular notches of the required diameter.

Rawhide Maul for Use in Heavy Work Does Not Deface Object Struck

THE accompanying photograph shows a method for making up a rawhide-faced maul for use in heavy rough work where the implement must not deface surfaces struck by it, yet must be rugged and strong. The first step in its making is preparation of a mold or form in which the foundry or casting shop can cast the main body of the maul, of brass, bronze, etc. This may be slotted, ribbed, hollow or arranged in any desired manner to govern the weight and rigidity. It must have the customary slot for the handle, in the center, well balanced. Each end is made in a plane parallel to the opposite end face and to the handle slot, and is cast so that a rim or ridge extends out from its edge forming a cup or depression of the desired diameter. A rawhide coil, 1 to 2-in. or more thick, and of diameter slightly larger than the rimmed cup or depression of the maul face, is forced into this rimmed depression under heavy pressure, a suitable wooden or other handle is inserted and set, and the maul is complete. When the rawhide face is damaged so it is no longer serviceable it is dug out and a new one installed, the rim being straightened if necessary.

Test Block for Pneumatic Tools

FOR testing pneumatic tools before they are taken out on the job or after they have been repaired, the repair shop of Standard Oil Co. of Indiana at Whiting has installed a heavy block of metallic lead, about 2 ft. square by 6-8 in. deep, mounted in a wooden frame. An air line is led to the block, equipped with a pressure gage, for operating equipment. Whatever the tool or head attached to it may be, it is applied to the surface of this block and tested. In the elevated frame at the back of the block is fitted a 3-in. segment of pipe of 10 or 12-in. diameter. Grinding wheels, cutters or other rapidly rotating members are tested by holding them inside this band of steel and driving them for some time at high speed, to see if they are properly rugged and trustworthy. The steel band prevents pieces of emery wheel, etc., from flying off into the shop and damaging equipment or workmen.



QUESTIONS on TECHNOLOGY

by W. L. Nelson

Depth of Well by Sound Reflection

Recently I have become interested in the use of the sonic principles in the pumping of wells and have been told that some 10 or 15 years ago, experimental work was carried on with such devices, and that it was widely reported in the trade journals. I would very much appreciate it if you could give me references in regard to this work.—N. D. F.

Two such methods have been described, the Depthograph and the Echometer, as well as the earlier devices that may have been developed 10 or 15 years ago. The Depthograph is described by C. P. Walker in Petroleum Development and Technology (1937) Transactions of A.I.M.M.E. Volume 123 (petroleum division) under the title "Determination of Fluid Level in Oil Wells, by the Pressure-Wave Echo Method." The Echometer is described by George Weber in the December 15, 1938, issue of The Oil and Gas Journal on page 44, under the title, "Fluid Indicator Useful in East Texas."

Both of these methods depend upon measurements of the time required for a sound wave or a pressure wave to travel to and from the liquid level or other surfaces in the well. Calibration is accomplished by noting the time required for the wave to return from some known position in the string of pipe or tools, such as the tubing catchers, the collars, or reflectors which are installed on the tubing at suitable intervals. One such deflector is described by Weber as "our design of reflector consists of a sheet-iron cylinder with conical ends welded to collars for slipping on over the string of tubing at any desired location." A small echo or sound reflection is obtained from each collar (or joint of pipe) but apparently these reflections are not employed in calibrating the equipment. Calibration in place is necessary because the velocity of sound or a pressure wave is a function of temperature, gas density, kind of gas, etc.

In the case of Echometer a sound wave is started by means of a blank cartridge, whereas in the Depthograph a pressure wave is created by releasing compressed gas into the casing. The lower-frequency pressure waves are said to travel farther and to deliver more energy than high-frequency sound waves.

The extent to which these methods are employed commercially is not known to this department.

Lube-Oil Number System

In your page of January 20, 1944, you mentioned the usefulness of a lubricating-oil number system based on industrial needs. Will you please give us your ideas?—F.C.A.

This is too comprehensive a question for this department but some ideas can be given. The one property that should be included in all cases in a classification system would be the viscosity. Although viscosities are now commonly given at 100° and 210° F., it would facilitate the system if a single temperature were employed. The temperature of 130° F. would be the best compromise in this respect because it would keep the viscosities of nearly all oils within the range of three-digit numbers.

In addition to viscosity, at least one other property of each oil will be of primary importance. For example, the viscosity index of automotive and diesel-engine oils will be of significance, or the pour point of a machine-gun oil will be of importance. Thus, a two-number system will, at the least, be necessary in describing most oils.

Types of Oils

The kinds or types of oils could be somewhat as follows, but obviously great attention should be given to the standard types of oils to make the system comprehensive and at the same time not too complicated. Several examples of each type of oil are included in the tabulation to further clarify the type of material visualized.

Eng.—Engine oils for spark-ignition engines, mineral machinery oils, motorcycle oils, aircraft-engine oils.

Diesel — Additive oils required for diesel engines, heavy truck or tractor engines.

E.P.—Extreme - pressure lubricants for heavy-duty gear boxes.

Pour—Low pour-point oils as refrigeration, machine gun, air conditioning machinery, hydraulic oils.

Colo—Technical or medicinal white oils.

Cyl.—Cylinder oils, straight mineral oils for air or steam cylinders.

Pres.—Preservative oils for machinery, corrosion protection, etc.

Turb.—Oils for high-speed machinery or steam turbines.

Spind.—Light oils for automatic machinery, sewing machines, spinning spindles.

The secondary properties of these oils (i.e., other than viscosity) would be somewhat as follows:

Eng.—Viscosity index
Diesel—Viscosity index
E.P.—Viscosity index
Pour—Pour point
Color—A.S.T.M. color
Comp.—Saponification number
Cyl.—(no secodary properties)
Pres.—Protection test (should be standardized)
Turb.—Emulsibility or demulsibility
Spind.—(no secondary property)

If the system were more complete, it would be possible to describe almost any kind of lubricating oil. The symbol representing the oil would be made up of:

1. The abbreviation or letters showing the kind of oil.

2. A number, the viscosity at 130° F., would appear next.

3. A second number giving the value of the secondary property.

Thus, an aircraft engine oil having a viscosity of 480 seconds at 130° F. (100 at 210° F.) and a viscosity index of 100 would be represented by the following:

Eng—480-100

In a similar way the regular S.A.E. automotive oils would be described thus:

Symbol—	Type	Vis.	V.I.
SAE 10W	Eng.	95	100
SAE 10	Eng.	105	*
SAE 20W	Eng.	130	100
SAE 20	Eng.	150	23
SAE 30	Eng.	220	65
SAE 40	Eng.	270	88
SAE 50	Eng.	345	46
SAE 60	Eng.	750	*
SAE 70	Eng.	1,000	*

*Viscosity index not specified.

Obviously a tabulation of the less vital properties of each of the kinds or types of oils would be useful and should be compiled.

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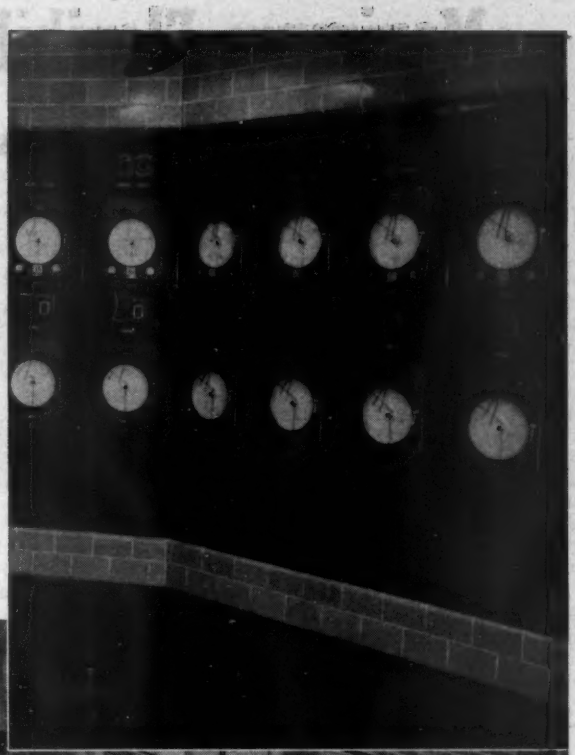

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IN HOME AND INDUSTRY

Paloma Cycling Plant Engineered for Maximum Flexibility and Efficiency

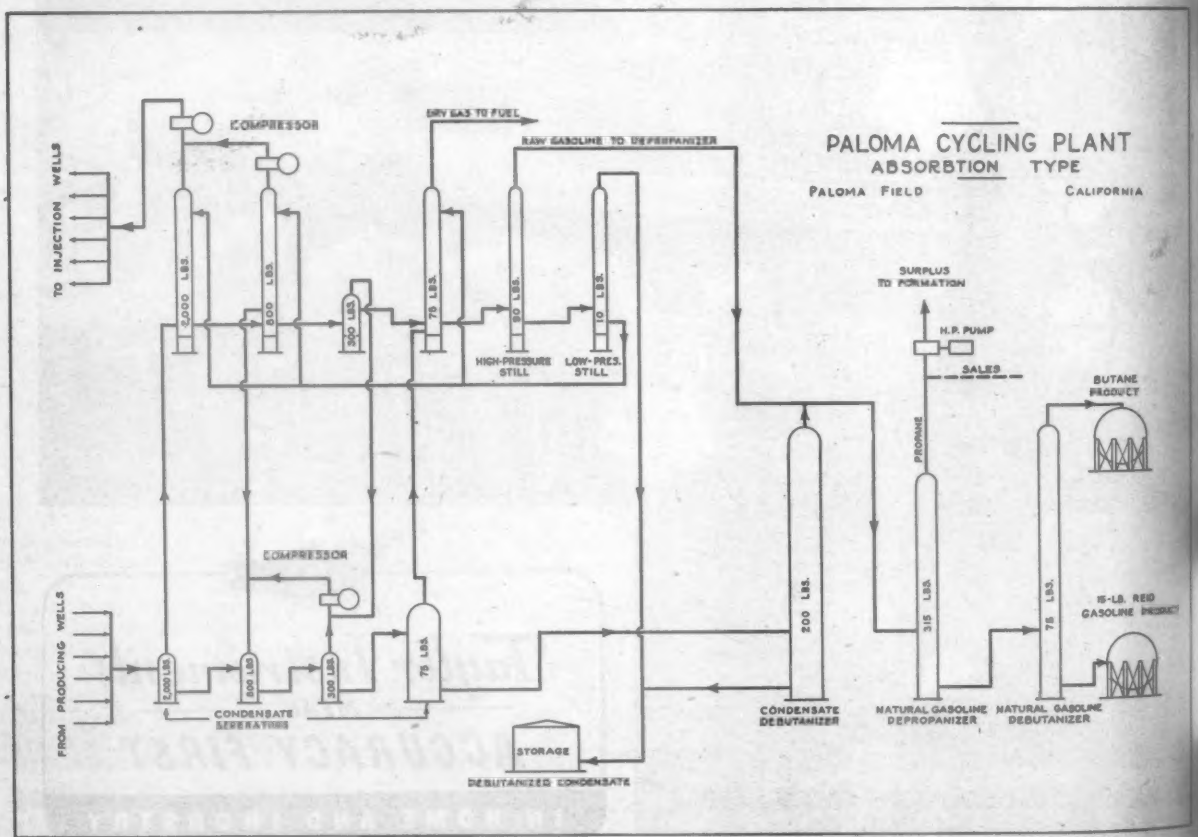
by L. P. Stockman

THE first cycling plant on the Pacific Coast, now under construction in the Paloma condensate field near Bakersfield in Kern County, is scheduled for completion during May 1944. This plant, which has been engineered to permit maximum flexibility and efficiency of operation, is designed to process 50,000,000 cu. ft. daily of wet gas and attendant fluid production from which will be recovered approximately 8,000 bbl. of total products consisting of debutanized condensate, butanes and natural gasoline. The cost of this program is being borne entirely by the companies participating.

A large part of the Paloma condensate field is located in what at one time was the eastern end of Buena Vista Lake which rose and fell from year to year depending upon seasonal rainfall variations. In order to protect the plant from possible future floods, a 5-ft. levee has been constructed around the plant area. Before construction started on the cycling plant, a series of shallow holes were drilled to determine the ability of the ground to sustain the weight of plant equipment. This soil survey proved valuable as it indicated the necessity of extra deep-seated foundations or piling. Foundations were used.

This plant, which will be completed in May, is designed to process 50,000,000 cu. ft. daily of wet gas and attendant fluid production. Cost is borne by participating companies.

It was recognized early in the life of the field that, in order to prevent loss of fluid in the reservoir and to permit a high over-all recovery, it would be necessary to maintain reservoir energy as near the original pressure as possible. Consequently, the operating companies in the field have kept the field shut in except for a pilot compressor plant which has been in operation for the past year making tests on the gas-injection capacity of selected wells. Under the plant-operation program, maintenance of reservoir pressure will be accomplished by returning to the formation the processed residue gas re-



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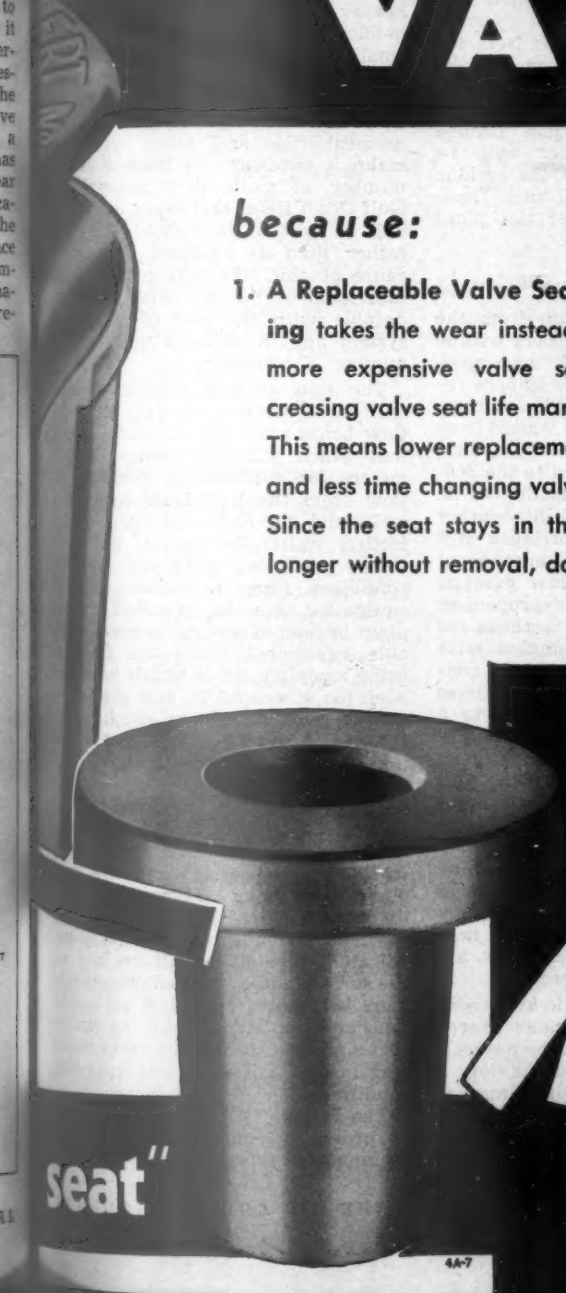

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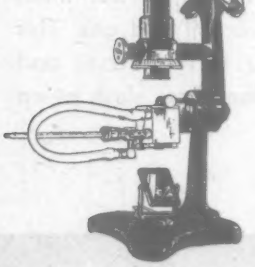
The Spencer Stereoscopic Microscope No. 26 extends the vision of the petroleum geologist, giving him vivid natural perspective in the examination of microscopic details. Optically and mechanically, it represents the highest scientific standards.



. . . in refining

Spencer Abbe Refractometers provide a quick and convenient means of controlling production of petroleum products by determining their optical properties—refractive index and dispersion.

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AMERICAN OPTICAL COMPANY

maining after the extraction of the liquid petroleum products. Approximately 44,000,000 cu. ft. of stripped gas will be returned daily to the Paloma reservoir.

Gas and liquid from the producing wells will be separated initially at approximately 2,000 lb. per sq. in. pressure. Pressure will be reduced by stages of 800, 300 and 75 lb. The fluid, or condensate, from the 75-lb. stage of separation will be stabilized through the condensate debutanizer and then sent to storage. Wet gas from the 2,000-lb. stage of separation will be run through an absorption tower operating at approximately the same pressure. Wet gas flashed from the 800-lb. stage of separation will be processed through an 800-lb. absorption stage as will the gas flashed at 300 lb. compressed wet to 800 lb. pressure. Residue dry gas from the 800-lb. stage of absorption will be compressed to 2,000 lb. pressure and then, with the dry gas from the 2,000-lb. stage of absorption, will be raised to 4,500 lb., the approximate pressure necessary to return the gas to the formation. Wet gas, flashed below 300 lb. pressure, will be processed at 75 lb. and the residue dry gas utilized as plant fuel. Compressor requirements for the plant operations total 3,600 hp.

Rich Absorption Oil

Rich absorption oil both from the 2,000-lb. and 800-lb. absorbers will be flashed in a rich-oil vent tank operated at 300 lb. pressure. Vapors released from this vent tank are commingled with the wet gas vented from the 300-lb. condensate separator, compressed to 800 lb., and fed to the 800-lb. absorber. Rich oil from the 300-lb. vent tank passes to the 75-lb. absorber and thence to a high-pressure still operated at 90 lb. The overhead cut from the 90-lb. still is raw gasoline which is sent to the depropanizer operating at 315 lb. The overhead cut from the still is commingled with the overhead from the 200-lb. condensate debutanizer. The bottoms from the 90-lb. phase are fed to a 10-lb. still where the overhead cut is sent directly to condensate storage along with the bottoms from the condensate debutanizer. The depropanizer, operating at 315 lb., delivers an impure propane product overhead. The bottoms are sent to a gasoline debutanizing column operating at 75 lb. The overhead from the gasoline debutanizer is a butane product, normal and iso, while the bottoms are a 15-lb. R.v.p. gasoline product.

No plans are being made at present for the recovery of propane except to provide connections on the natural-gasoline depropanizer for taking a side cut of fair purity if a market develops. Otherwise, the overhead from the depropanizer will be handled by pumps as a liquid for injection into the formation. The plant is being constructed to perform with high efficiency and will recover better than 85 per cent of the total butanes from the well effluent.

The boiler plant will consist of two units operating at 350 lb. and will supply steam for still agitation and the operation of pumps. All of the oil circulation pumps will be driven by multicylinder gas engines. The absorption oil will be slightly heavier than the kerosene grade used generally on the Pacific Coast. All absorption oil will be heated by direct-fired heaters.

Field Pipe-Line System

The field pipe-line system is unusual inasmuch as it will consist of individual 3½-in. lines to and from each well, producing and injection, whereas the normal plan is to use a header system which is more economical in fields requiring only a small number of wells which are grouped together in two or three areas. The lack of uniformity in the Paloma reservoir, however, and low permeabilities and other anomalies make it necessary to have a larger number of wells than normal for Gulf Coast fields and also these wells will be spaced throughout the field rather than in localized areas. Because of this, the cost of installing individual-well lines will be comparable with the cost of a header system and in addition will have a number of advantages.

The flow to and from each well will be controlled at the plant by flow beans placed in the header system which will also contain orifice meters for determining the rate of flow from the individual producing wells and gas to be returned by injection wells. Testing of the individual producing wells will also be simplified since permanent testing equipment may be installed at the plant instead of having to move portable equipment about the field or using sampling tubes which have not been too successful on low ratio production such as will be produced at Paloma. Also backflowing of injection wells may be done without commingling the dry gas with wet gas to be processed which would cause the loss of plant products. All field pipe lines will be constructed for 5,000-lb. working pressure so that the producing wells may be converted readily into injection wells by changing the header connections at the plant. All field pipe lines will be laid on the surface and supported on concrete piers because of corrosive soil conditions and insulated against the weather to prevent formation of hydrates and insure uniform plant operating conditions.

The Paloma field has been unitized in order to enhance the pressure-maintenance program. Approximately

2,500 acres are included in the unitized area and this may be expanded as outside areas are proved productive. Six companies are participating in the Paloma unit plan. These are Barnsdall Oil Co., General Petroleum Corp., Ohio Oil Co., The Texas Co., Union Oil Co. and Western Gulf Oil Co. Western Gulf has been selected to supervise construction of the cycling plant, development of the field and for subsequent management of plant and field operations. The actual operating policy is dictated by the Paloma Operators Committee headed by R. P. Huggins of Western Gulf as chairman and advised by engineering, geological, accounting and legal subcommittees.

The Texas Co., which will handle a major part of the production from the Paloma field, is laying 9 miles of 6-in. pipe line from Paloma shipping tanks to the Emidio pump station of General Petroleum Corp. and in order to move this oil from Paloma to Emidio the company is building a pump station at Paloma. At Emidio pump station, The Texas Co. is building tankage to accumulate sufficient oil to permit General Petroleum to batch it through to Los Angeles Harbor where it will be delivered to The Texas Co. for refining. General Petroleum's pipe-line facilities from Emidio are being employed in the movement of this oil because Texas Co. does not have a direct pipe line southward to Los Angeles. Its pipe-line facilities from the San Joaquin Valley extend westward to Estero from where oil is moved by boat to other points.

Petroleum Technicians Trained for Army Service

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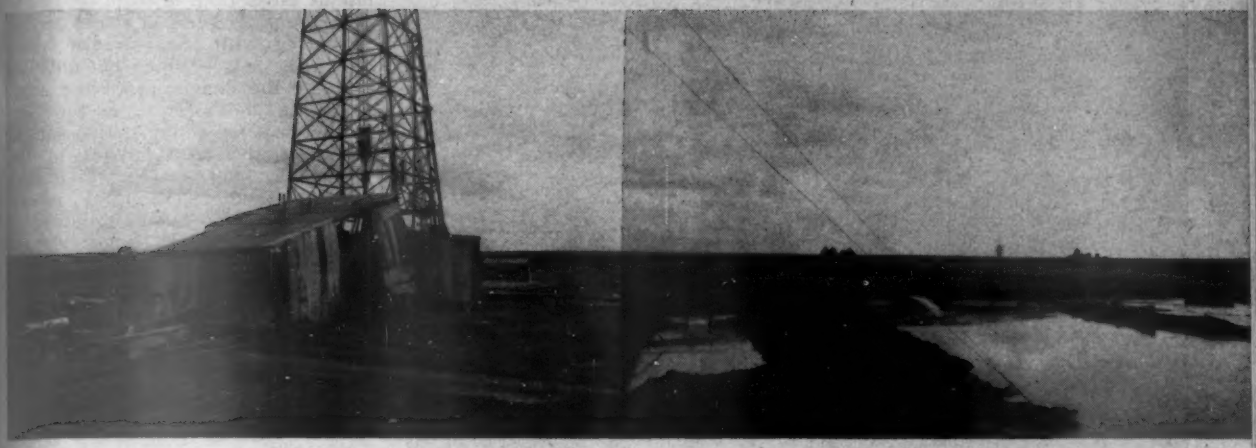


Mud-system layout on power-rig operation in West Edmond field. Circulation for this job, now drilling upper formations, is through long return discharge line to reserve pit at right, back through settling pit (center) and suction pit (left foreground) to pump at back of rig

Mud Conditioning in West Edmond Field Involves Special Treating Problems

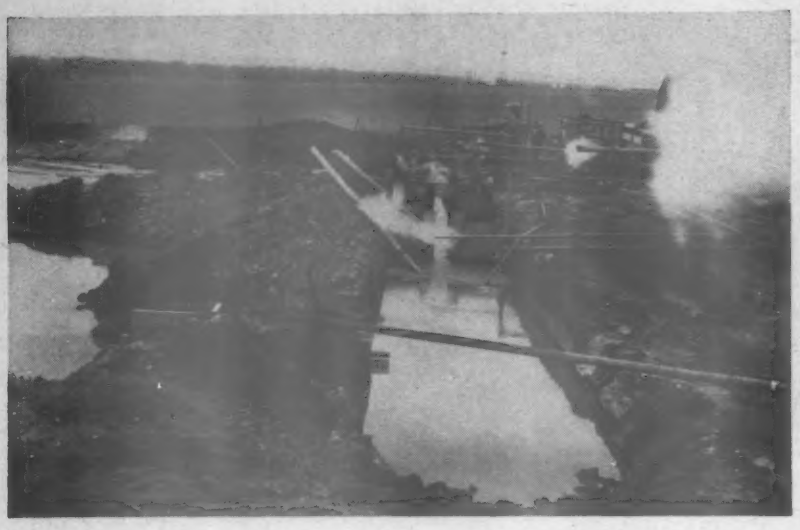
by Neil Williams

Through effective application of chemicals drilling contractors in the West Edmond field have been able to overcome the contaminating effect of high calcium and magnesium concentrations in water used in mixing muds and thus provide drilling fluids having the characteristics needed to control the formational hazards existing in the field. Mud control is one of the most important phases of operation in the field. Practices being adopted are described in this article.

CONTROL of drilling mud is one of the most important phases of operation in development of the West Edmond field, Oklahoma County, Oklahoma. Through conditioning and treating practices being adopted, various formational hazards encountered in the wells are being overcome, and successful completion of holes and running and cementing of production casing strings facilitated. With this trouble from sticking of drill pipe, twistoffs and fishing jobs which characterized many of the earlier operations in the field has been alleviated, drilling time has been substantially reduced and other benefits derived.

Adoption of an effective mud program and conditioning and control of desired mud characteristics have been confronted with a number of complications, chief of which has been the necessity for using a water in mixing muds that contains an unusually high content of calcium sulfates and other mud-contaminating salts. All available

Power rig operated by Kerlyn Oil Co., one of the largest drilling contractors in West Edmond field



Long, baffled mud pit at side of steam rig operated by Herman Wegener showing portion of reserve pits at left through which drilling fluid is being circulated

water in the field, which must be obtained from a small spring-fed creek which runs through the field, tests around 44 grains of hardness. This has occasioned the instigation of special chemical treatment to eliminate calcium and magnesium or counteract and neutralize their contaminating errect. In addition to the high content of calcium sulfates present in the makeup water used in mixing, a high yield of chlorides is picked up in drilling which intensifies the treating requirements.

Casing Program

The casing program generally followed in the field calls for the use only of a 5½-in. production string in addition to the surface pipe. At least 300 ft. of surface casing is required with some operators lately setting as much as 425 ft. With 5½-in. oil string, 10¾-in. pipe usually is run for the surface casing, for which the practice is to drill 11-in. hole and ream to 13¾ in. Below the surface, 8¾ or 9-in. hole then is carried without reduction to the producing horizon, which is in the Hunton lime at 7,000 to 7,100 ft. This involves maintaining a total of 6,600 to 6,800 ft. of open hole.

Because of sands and other loose formations in which returns can be lost and which have a tendency to cave, most contractors now use from 20 to 30 sacks of bentonite for drilling surface hole. Loss of returns in drilling is not important, but a number of wells started only with water have experienced trouble with hole bridging after or while running casing, preventing cement circulation to the top and thus resulting in poor cement jobs and possible casing failures. Addition of the bentonite to the drilling fluid helps to insure holding up the walls of the hole while running pipe and getting cement returns.

The principal hazard in carrying the long open hole below the surface casing lies in negotiating the Pennsylvanian shales, comprising a section from about 5,200 ft. to around 6,500 ft., and holding up the walls of this section while completing the remainder of the hole. These shales are soft and disintegrate easily if the walls are not adequately built up and protected. Disintegration and caving of the shales cause the drilling of enlarged hole with consequent reduction in the velocity and carrying power of the mud to lift the cuttings and cavings to the surface. Under such circumstances the cuttings and cavings may settle out and accumulate at the bottom or form bridges to stick the pipe. The soft shales are interspersed with hard streaks which remain as ledges which not only accentuate the danger of caving accumulations and sticking of pipe but also create an eddying or whirling action of the mud stream in the "bellies" between them which may intensify the washing away of the hole walls.

Dilution of Chlorides

Down to these shales no mud is added to the hole and no particular treating or conditioning of the fluid is undertaken other than to provide the maximum dilution of the chlorides and contaminating salts picked up in drilling. The formations consist largely of red beds, water sands, lime and shells. There are no unusual drilling difficulties and no upper oil or gas horizons or other formations to protect, and full advantage of this is taken to reduce total mud costs and total drilling time, offsetting some of the mud costs and slower drilling in the lower portion of the hole.

In drilling this section of the hole, the general practice is to circulate through the reserve pit, allowing an extra long flow of returns for maximum dropping of cuttings. For dilution of chlorides picked up, water is added copiously to the system. In this the water loss of the fluid rises to a range up to 70 cc., and the viscosity is allowed to run down to about 30 to 31 seconds (Marsh funnel) and the weight to 9.5 lb. The chloride content, however, is reduced from a range of about 0.75 to 0.8 per cent to from 0.2 to 0.3 per cent.

Mud-pit layout provided by Arrow Drilling Co. on diesel-rig operation in West Edmond, showing shale shaker installed on the end of return discharge

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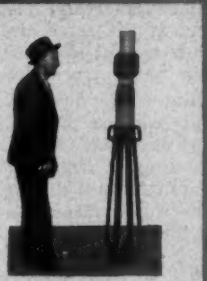
3. In step three, slide the Protector up close to the tool joint before snapping on the Split Sleeve.



4. Insert tool joint sleeve and protector unit into the Remover Tool after lubricating split ring and tool joint with paste.

5. See that Expander Dogs are uniform before pulling upward. If necessary, use a loop of soft line through the handles.

6. Raise drill pipe slowly. Protector will climb up over the tapered sleeve and on to the tool joint.

7. As drill pipe is raised still farther protector will drop inside the removing tool.

8. Remove split ring with hatchet or screwdriver. Operation is complete.

Although some risks are incurred by this procedure they are not considered sufficiently great to justify the expenditures which would be involved in providing mud. Some loss of returns occurs in various formations but this is overbalanced by the volume of fluid circulated. Important time savings are made by the faster drilling.

Drilling Shale Section

Drilling of the shale section calls for the use of muds having low water loss and good walling properties to seal the walls effectively and prevent infiltration and consequent disintegration of the soft shales, a relatively high viscosity to insure carrying power to remove all cuttings and cavings to the surface and keep the hole clean, and at the same time a sufficiently low weight to forestall loss of returns in porous formations.

Bentonite and various high-yield clays and gels are liberally used to build up viscosity. After being allowed to drop to from 30 to 31 seconds (Marsh funnel) during the drilling of the upper formations, the viscosity is increased steadily to around 38 seconds by the time a depth of 6,000 ft. is reached and to form 42 to 44 seconds before the Oswego lime section just below the shales is entered. The relatively high viscosity is particularly important in that most rigs in the field do not have sufficient pumping capacity to insure adequate circulating volume and velocity at those depths.

Since there are no high pressures down to the producing horizon to be controlled, high mud weights are not required. From a pressure-control standpoint there is no occasion to carry a weight of 9.5 to 10 lb. per gallon. In view of this, the principal concern in weight control is to lighten the mud to a range that excessive returns will not be lost in the porous formations. The greatest trouble with loss of returns is most likely to occur in the Oswego lime, just below the shale section around 6,500 ft. Many of the stuck-drill-pipe cases and twistoffs that have been experienced in the field have occurred while drilling at this depth. Down to the Oswego lime, mud weight is not closely controlled. In drilling the upper formation it largely takes care of itself by reason of the large volume of water circulated to dilute the chlorides. However, with the addition of muds and building up viscosity, it has a tendency to build up when drilling the shales, and sufficient makeup water has to be added to the system to lighten it. General practice is to hold the weight to a top range to 10.1 to 10.2 lb. while drilling through and particularly below the shales. It has been found that when the mud weight is allowed to exceed that range excessive loss of returns is likely to occur in the Oswego and give trouble, while with lower weights, the loss of returns can be controlled readily, especially with the addition of wall-sealing material to the mud.

Preparation for Treating

Preparatory to starting mud conditioning for entering the shale section, the pits are thoroughly cleaned, a shale shaker is put on the return discharge, and circulation is switched from the reserve pit to the regular pits. The next step is get the system in condition to receive the new mud. This generally consists of adding soda ash and tannic acid in the ratio of 1:1 to the makeup water and circulating at least 16 hours before adding and treating new mud.

Chemical treatment is an important phase of the program and generally is depended upon exclusively for control of water loss. Addition of the soda ash is occasioned by the high calcium sulfate content of the water which has to be used. It serves to convert the calciums to sodiums, or at least neutralize them to make possible hydration of the clays and bentonite and obtain maximum effective recovery and dispersion. Circulation of the treated water serves to prepare the drilling fluid in the system and mud already made to get maximum advantage of the new mud to be added. The chemical treating program is one of constantly fighting the contaminating calciums and magnesiums of the makeup water and the chlorides picked up in drilling.

By the rather drastic initial chemical treatment resorted to, water loss of the drilling fluid in the system is dropped from about 70 cc., as carried in drilling the upper part of the hole, to within a range of 35 to 40 cc., before the addition of any new mud. Moderate use of chemicals is made later as makeup water is added with consequent further reductions in water loss. Usually the water loss of the mud is dropped to about 25 cc. by the time a depth of 6,000 ft. is reached, and to as low as 16 to 18 cc. for the drilling of the remainder of the hole.

Following the initial treating and conditioning of the system while circulating for about 16 hours, bentonite, clays and gels are added to build up viscosity and other mud properties. The amount added initially depends largely on the volume of old mud taken from the pits during the initial cleaning. Usually from 30 to 60 sacks are required. Through the effect of the soda ash and tannic acid treatment, the initial gel is held down to a range low enough that drilling progress is not slowed by the increase in viscosity. Treated makeup water is added as needed to maintain volume and lighten the mud.

Lost-Circulation Materials

To increase mud yields while drilling, the pH of the mud, which normally is in range of 7.3 to 8, is raised to 8½ to 9. Raising the pH is the reverse of the program in many areas, particularly on the Gulf Coast, where shales are bentonitic and it is desired to hold down mud yields.

After negotiation of the shale section and before going into the Oswego lime where returns can be lost, general practice is to take off the shale shaker. The reason for this is that lost-circulation materials usually must be added and the shaker would serve to remove them from the system, which is not desired. For prevention of lost circulation, most contractors are confining themselves to chemically inert materials. While hulls have been used in many in-

Portable mud-testing equipment used by Kerlyn Oil Co. In the picture is G. O. Danielson, mud engineer for this contractor

stances, these tend to deteriorate in time and form organic acids which affect the mud control adversely.

Particular precautions must be taken to insure maintenance of mud characteristics built up during drilling the shales. Close control of mud weight must be held at a top range of 10.1 to 10.2 lb. per gal. to reduce the chance of lost returns. Viscosity is sustained at from 42 to 44 seconds, and water loss at from 16 to 20 cc. In the lower portion of the hole formations become harder, which materially slows up drilling. The time factor in this is an important consideration in the mud control since the walls of the shale section must be held up during this period and while running casing to insure a good cementing job.

Mud costs in this program run from about $1,000 to $1,500 of which approximately $500 usually is paid by the contractor and the excess by the operator. These costs, however, have been more than offset in most instances by the savings effected by the elimination of trouble and completion of a good hole. While mud costs in excess of $500 are generally assumed by the operator, contractors are responsible for the proper conditioning and treating.

Pressure Break for Salt-Water-Disposal System

We are having trouble with our salt water-disposal system from two wells on different leases. A 2-in. gravity line 1 mile in length and with 25 ft. of fall was installed from the settling tank at the first well completed and took care of 150 bbl. of water per day. We also installed a rotary pump for emergencies. When the second well was completed we tied it into the salt-water system also. The well is making 250 bbl. of water per day and the tank is approximately 30 ft. higher than the one at the first well. The water from the tank battery at No. 2 prevents entry of water from No. 1 tank into the system. When No. 2 is shut off so that the rotary pump can be used to empty No. 1, there is danger of its backing up and overflowing. Can you suggest a simple remedy for this condition?—C.F.C., Ada, Okla.

The simplest and most effective means would be to put a pressure break in the line from No. 2 well adjacent to No. 1 settling tank. This consists principally of emptying the line from No. 2 tank into a reservoir of the proper height at that point. This same principle is used to bring water down from the tops of mountains in order to avoid excessive pressures at the bottom. The water is emptied into intermediate reservoirs and then put into a line to the next lower reservoir. The pressure is dependent on the effective head in each line.

The pressure break could be made by installing a small tank (5 bbl. capacity should be sufficient) on a scaffold of the proper height. The line from No. 2 well could then be emptied into this tank (entry could be either top or bottom) while a second line from the bottom of the tank could go to the suction of the rotary pump and thence into the disposal line. It would probably be best to put a check valve between the discharge from the pressure break and the pump suction.

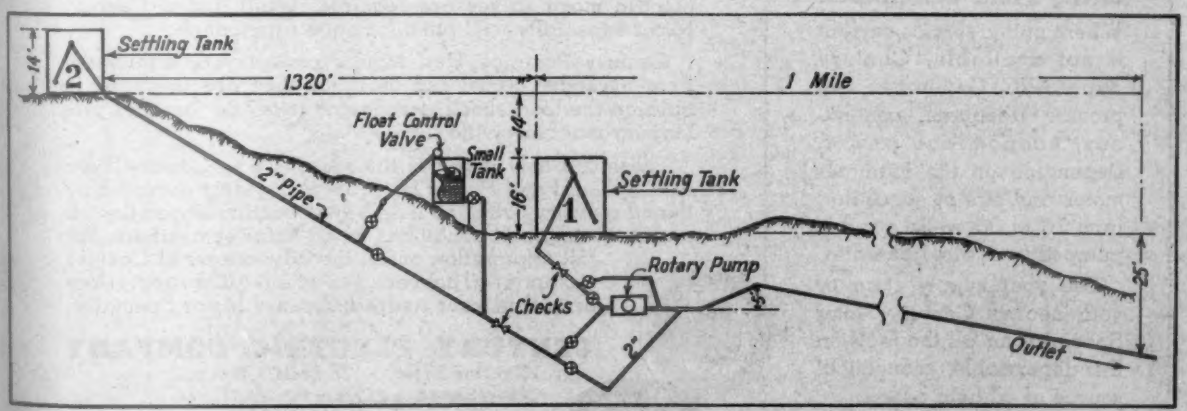
This system has an advantage in that the pump can be used to put water through the lower 1 mile of the line from No. 1 tank to the disposal point. It may be necessary to operate with pressure below No. 1 tank as the gravity capacity of the 2-in. line may not be great enough to take care of the flow. As the throughput is increased and the velocity in the pipe is speeded up the pressure drop increases about two to one. Doubling the throughput increases the pressure drop four times, the drop for a 2-in. line at 10 gal. per minute delivery being 0.12 lb. per sq. in. per 100 ft., of line and that for 20 gal. per minute being 0.42 lb. per sq. in. per 100 ft. of line. In addition the diameter of the line may have already decreased due to scale deposition since installation and this would further increase the velocity; the pressure drop for 1.5-in. pipe is 0.47 lb. per sq. in. per 100 ft. of line at 10 gal. per minute discharge.

In order that the pressure on the pump suction will be the same from both lines, it may be necessary to fix the pressure break on the line from No. 2 well so that its fluid level may be adjusted to fit the height of the grasshopper on the No. 1 tank. This will not be necessary if the pressure head (and the grasshopper) on No. 1 tank is to be maintained at one position. Water level in the reservoir at the pressure break should be even with the top of the grasshopper on No. 1 tank.

It would also be well to provide a bypass around the rotary pump from the pressure break on No. 2 line, the same as has been provided on the line from No. 1 tank.

The reservoir on the pressure break should be equipped with a quick-closing valve controlled by a float. Then if anything goes wrong with the system and the fluid level gets too high in the reservoir, the flow on the line from No. 2 tank will be shut off.

The accompanying sketch shows an installation with the suggested arrangement.



Salt-water-disposal system layout showing installation of pressure break

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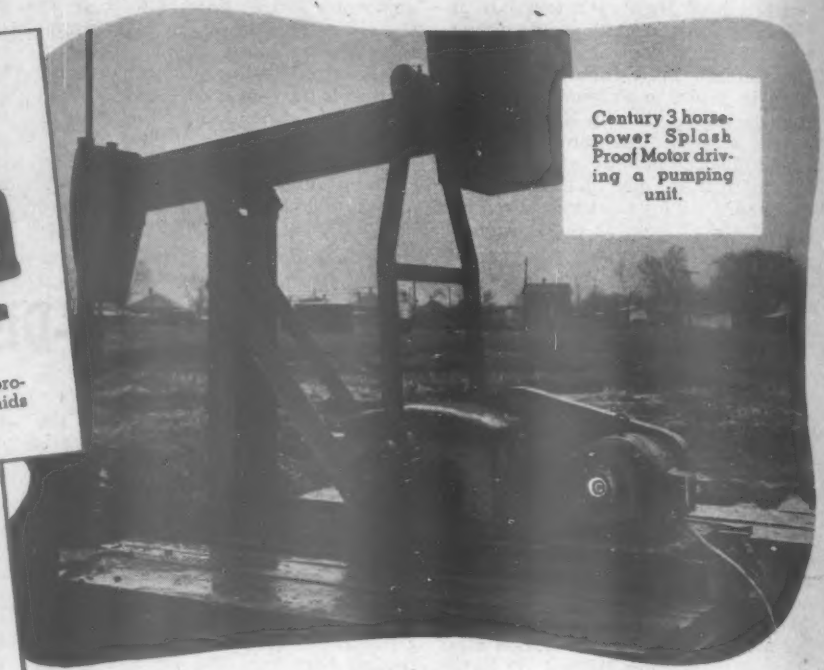

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Century Explosion Proof Motor for refinery installations.

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Engineering Fundamentals

No. 130

A FEATURE OF THE OIL AND GAS JOURNAL

DETERMINING SAND CONTENT

THE elutriation method of measuring the sand content of rotary-drilling fluids was discussed in last week's installment of this series. Three additional methods will now be described.

Centrifugalizing

The centrifugalizing method employs a centrifuge apparatus of the type used in oil fields for determining the water content of oil.

The centrifuge tube that is used is the standard tube specified by the A.S.T.M. Designation: D96-40. This tube may be pear-shaped as shown in Fig. 1-A or cone-shaped as shown in Fig. 1-B. The centrifuge tube is filled to the 20-cc. mark with the mud to be tested. The mud is diluted with fresh water to the 100-cc. mark. The contents of the tube are thoroughly mixed. The tube of diluted mud is then centrifuged for from 3 to 5 minutes at a speed of 1,500 r.p.m.

It will be observed when the centrifuge tube is removed that there is no definite line of demarcation between sand and silt in the bottom of the tube; instead, there will be a gradual change from coarsest sand to finest silt. For this reason, different observers may not agree on the division mark between sand and silt, and consistency of results is not as easy to attain as in some of the other methods. If the method as outlined is used, the volume of sand is read directly from the graduation on the tube and multiplied by five to obtain the percentage of sand in the undiluted mud sample.

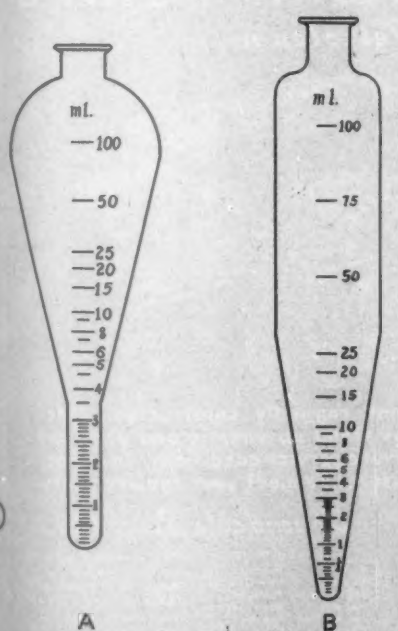

Fig. 1

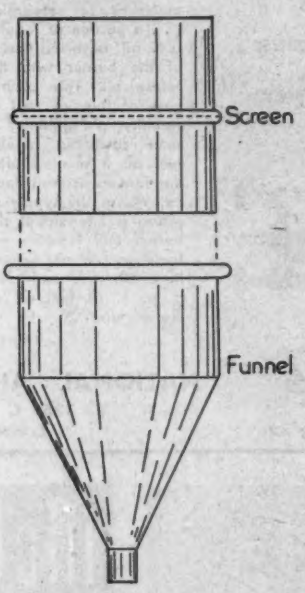

Fig. 2

Settling

A rather rough, but quick and convenient, method of determining sand content involves the use of the 250-cc. elutriation tube described in Installment 129. A 75-cc. sample of mud is placed in the tube and diluted with fresh water to the 250-cc. mark. The diluted mud is then agitated violently by shaking. The tube is then allowed to stand 30 seconds and the volume of settled solids is read. A settling time of 30 seconds is chosen because this is the approximate time required for a 200-mesh sand particle to settle from the top to the bottom of the tube. When making such a test on a mud containing heavy minerals as weighting materials, the readings may be high. This is because particles finer than 200 mesh, due to their greater density, may settle as rapidly as 200-mesh sand particles.

This method has the advantage of being simple and rapid. On the other hand, it can hardly be expected to yield as accurate results as either the elutriation method or the sieving method.

Sieving

The sieving method of measuring sand content is becoming popular because of its simplicity, convenience, and accuracy. It employs a 200-mesh screen 2½ in. in diameter and fitted with a removable funnel. The screen and funnel are shown in Fig. 2.

In measuring the percentage of sand by this method, a definite volume of mud is measured in an elutriation tube, or in a centrifuge tube and diluted with water. The funnel is attached to the sieve. The diluted mud is poured onto the screen and washed with a small stream of clear water until all of the fine mud particles have washed through the screen. The screening is facilitated by tapping the sieve assembly on a solid surface.

The funnel is then detached and placed on the opposite end of the screen. The sand is washed from the screen into the elutriation tube by holding the small end of the funnel over the tube and pouring a fine stream of water through the screen until all sand is removed from the screen. The sand is allowed to settle in the bottom of the tube, and the volume of settled sand is noted. If the elutriation tube is used and a 75-cc. sample of mud is taken, the volume of settled sand read from the tube is taken directly as the percentage by volume of sand. If the centrifuge tube is used, the volume of sand obtained from a 100-cc. mud sample is the percentage by volume of sand.

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Stern, A. George, "Role of Clay and Other Minerals in Oil-Well Drilling Fluids," U. S. Bureau of Mines, R.I. 3556, 1941.

A.S.T.M. Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (A.S.T.M. Designation: D96-40).

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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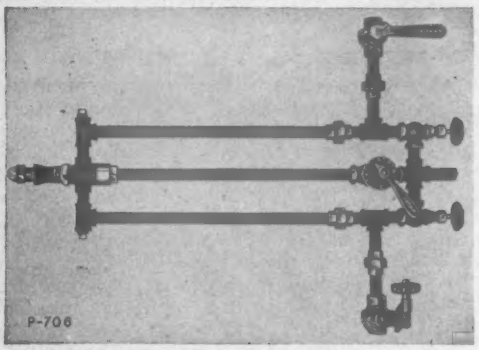

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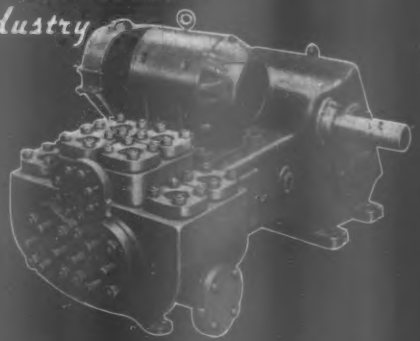

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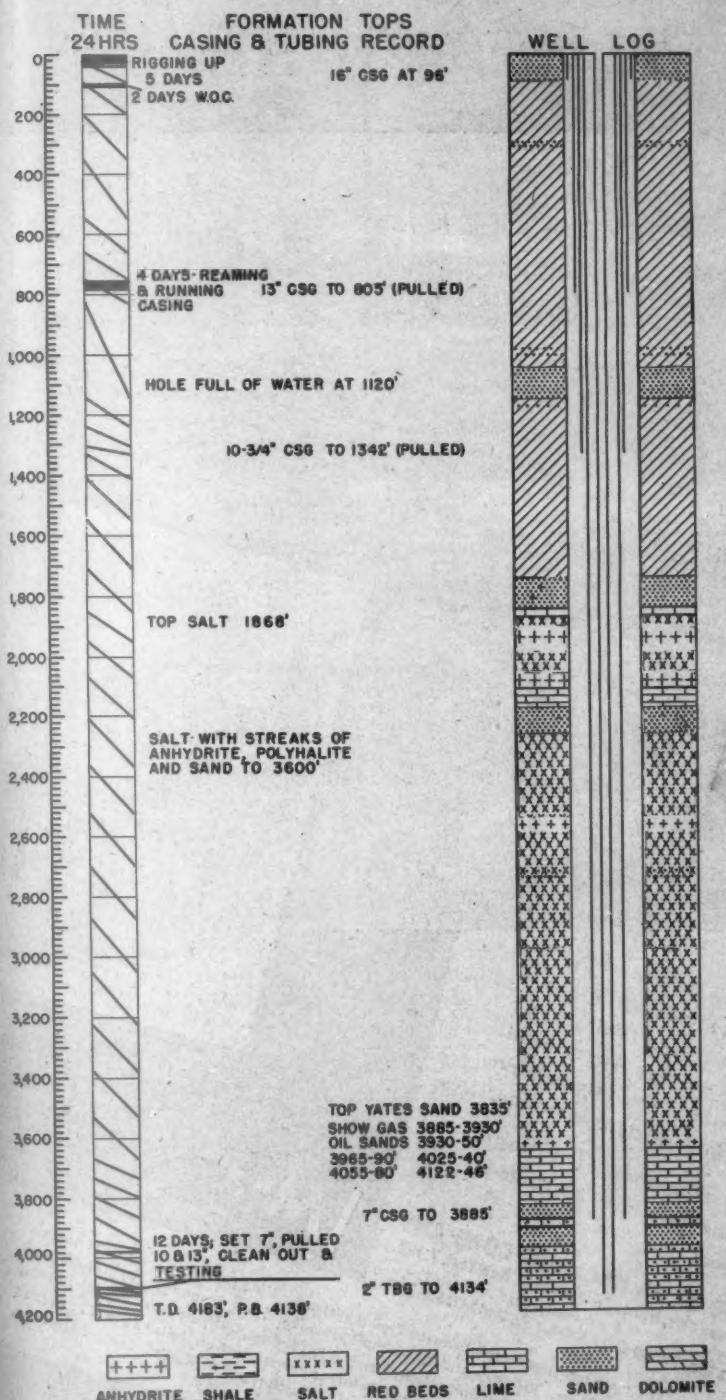

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DRILLING DATA

Elevation, derrick floor, ft.	3,621
Rigging up, days	5
Drilling time, includes testing and completion, days	74

CASING AND TUBING RECORD

Size (in.)	Weight (lb.-ft.)	Depth (ft.)	Cement (sacks)
16	70	96	75
13	50	805	none
10¾	50	1,342	none
7	20	3,885	100
2		4,134	

COMPLETION

Plugged back to 4,138 ft. and shot with 200 qt. at 4,025-4,136 ft.

PRODUCTION TEST

Time pumped (hr.)	24
(Last 24-hr. period of 5-day) tests)	
Oil (bbl.)	122
Gas (cu. ft.)	15,000
Water (bbl.)	2
Gas-oil ratio	123:1
Gravity at 60° F.	34.3

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REFINING

Additional Speakers Named For W.P.R.A. Convention

Two more speakers have been announced for the annual meeting of Western Petroleum Refiners Association, to be held March 28 in the Jefferson Hotel, St. Louis. Comdr. P. H. Winston, assistant executive, special assignments, in Selective Service System, Washington, will speak on "Selective Service." Fayette B. Dow, Washington counsel for the association, will talk on an unannounced subject. The meeting will open with the president's annual address by C. L. Henderson.

Speakers previously announced are W. W. Vandeveer, director in charge, District 2, Petroleum Administration for War, Chicago; Bruce K. Brown, assistant deputy administrator, PAW, Washington, and Paul G. Ryan, chairman of committee on postwar planning, Petroleum Industry War Council, Cleveland.

Rear Admiral Smith to Speed Building of War Plants

HOUSTON.—Rear Adm. Norman M. Smith, U.S.N., has been assigned to serve as superintendent of civil engineers, area A, to expedite construction of plants designed to produce aviation gasoline. His office is in this city, and the preliminary staff includes Lt. W. K. Adams, former officer in charge of construction at Galveston; Lt. Carl E. Rohde, present officer in charge of construction at

Those refinery and transportation executives participated earlier this month in ceremonies accompanying delivery of the twenty-millionth barrel of oil over Standard Oil Co. of New Jersey's war-emergency racks at Linden, N. J. Standing are Boyd Wilson, Petroleum Industries Committee; Donald L. Ferguson, general superintendent of Standard of New Jersey's Bayway refinery; H. T. Frushour, general manager of the New York district, Pennsylvania Railway Co.; Capt. L. A. Puckett, U.S. Navy, officer in charge of the petroleum pool; J. Raymond Carringer, vice president and general manager of manufacturing for Standard of New Jersey, and William Colthart, manager of Distillers Co., Ltd.'s plant at Linden. George H. Mettam, seated, is assistant general manager of manufacturing and manager of the New Jersey works for Standard of New Jersey

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Galveston, and Miss Mildred McGinty, secretary.

The Houston office is under the jurisdiction of the superintending civil engineer for the Navy at New Orleans, Rear Adm. J. T. Mathews.

Admiral Smith was formerly chief of the Navy's bureau of yards and docks and is a graduate of the Naval Academy in the class of 1906.

The Houston office will coordinate its work with the director of construction for the PAW and with representatives of oil companies having contracts with the Government to provide needed additional refining facilities.

Admiral Smith will place emphasis upon the completion in the shortest possible time of "certain petroleum refineries now under construction and improvements in those designed to produce high-octane fuel."

Shell's Martinez Refinery Receives E Flag Award

SAN FRANCISCO. — Ceremonies with a military setting marked the award of the Army-Navy E flag for excellence in production of war materials at the Martinez refinery of Shell Oil Co., Inc., February 19. The presentation on behalf of Under Secretary of the Navy James Forrestal, was made by Rear Adm. Carleton H. Wright, commandant of the twelfth naval district.

Col. William B. Cobb, secretary to the general staff, Western Defense Command, awarded individual E award pins to Grace Carter and Joseph Peters, representing the large group of refinery employes.

I. M. Hemphill, refinery manager, accepted the industrial award from Admiral Wright on behalf of the employes and the company. James Douglas responded for the employes.

Employes' Retirement Plan Adopted by Sonneborn

NEW YORK.—L. Sonneborn Sons, Inc., oil refiners, have adopted an employes' retirement plan which provides monthly pension payments and death benefits without cost to the individual participant. Supplementing Federal Social Security the plan is designed to provide retirement incomes commensurate with the normal living standards of men in income brackets above the $3,000 Social Security limit.

Mexican Refinery Contract Is Awarded to McKee

CLEVELAND.—Arthur G. McKee Co., engineering and construction organization of this city, has been awarded by Petroleos Mexicanos the contract for an oil refinery in Mexico City to cost $15,000,000. The project is being financed in part by Export-Import Bank, of Washington, for purchases of materials and equipment in the United States. Construction of the plant is expected to require about 18 months.

Sketches of Plant Operators

J. D. WADDELL, superintendent of the Skelly Oil Co. refinery at Longview, Tex., was born in Danbury, Iowa, and received his preliminary schooling in that town. He then entered State University of Iowa, graduating with a bachelor of science degree in chemical engineering in 1924. He didn't make a hurried leap into the oil business. Instead he spent the next 4 years as principal and superintendent of the public school at Van Cleve, Iowa.

Following this experience Waddell enrolled in the Graduate College at State University of Iowa, from which institution he received his master degree in chemical engineering in 1929. He spent a year as assistant chemist at a rubber plant in Hannibal, Mo. In May 1930, he joined Skelly as research engineer in the development and research department at Eldorado, Kans. He served as assistant director of research for about a year before becoming chief process engineer in March 1941. He held that post until January 1, 1942, when he was advanced to his present position as superintendent at Longview.

Natural Gas

No Sweet Gas for Carbon Black, Says Commission

AUSTIN.—Texas Railroad Commission last week denied an application of War Production Board to utilize 20,000,000 cu. ft. of sweet gas daily in the Panhandle area for manufacture of carbon black. Texas law stipulates that only sour gas may be used for this purpose, but it had been suggested that the law be ignored in this case. The letter of refusal, signed by Beauford Jester, chairman of the commission, was addressed to Thomas J. Starkie, chief of the pigment division, Petroleum Administration for War and an executive of Carbon Black Co.

The statement said carbon-black plants are operating at only 30 per cent of capacity and that the pipe line from South Texas to West Virginia, now under construction, is expected to take 100,000,000 cu. ft. of gas out of the state daily. Jester asserts that there is enough sour gas in the Panhandle to supply carbon-black needs.

California Looking at Texas As Source of Needed Gas

WASHINGTON. — Construction of any pipe line designed to move natural gas from the Texas Panhandle to California will have to be a postwar enterprise, federal officials here indicate. Building of such a line to supplement California's production is said to be contemplated by Southern Counties Gas Co., of Los Angeles, subsidiary of Pacific Lighting Corp.

As a preliminary to the project approval would have to obtained from various government agencies, beginning with the natural gas division, Office of War Utilities, a unit of War Production Board, granting priorities for such materials as steel pipe.

James Pew, natural gas director of Petroleum Administration for War, which would be consulted, said he had heard about the reported Texas-California line unofficially.

Biggest Gas Field Linked to Cities Service System

BARTLESVILLE, Okla.—The Hugoton gas field, one of the largest in the country straddling the Oklahoma-Kansas border, has been linked to Cities Service Gas Co.'s transmission system by the tie-in of Cities Service Transportation & Chemical Co.'s new 26-in. line from that field to Blackwell, Okla. This makes available to Cities Service Gas Co. customers vast gas reserves. The company's holdings in this area consist of 173,025 acres, with estimated reserves in excess of 2 trillion cubic feet of gas.

Federal Power Commission will hold a hearing March 29 in Washington on an application filed by the two Cities Service companies for authorization of Cities Service Gas to operate the 231-mile line under the terms of a proposed lease from Transportation & Chemical. On March 30 it will hold hearings on applications by the two companies for permission to construct and operate additional facilities to increase the capacity of the new line.

It is planned to have Transportation & Chemical construct and Cities Service operate seven additional 1,200-hp. gas compressor units and related facilities to be installed in the Guymon, Okla., station at an estimated cost of $1,298,354, and an application by Cities Service Gas Co. for authorization to construct and operate a cooling tower at the applicant's Blackwell station, Kay County, Oklahoma, and 35 miles of 16-in. loop line from the Blackwell station to Osage County, Oklahoma, at a total estimated cost of $724,300.

The additional compressor units will increase the capacity of the Guymon station to 213 million cubic feet of gas per day.

Natural Gasoline

N.G.A.A. to Hold Postwar Planning Conference

The twenty-third annual convention of Natural Gasoline Association of America, to be held April 12-14 in the Baker Hotel, Dallas, is designated as a "War Products and Postwar Planning Conference." James W. Vaiden, vice president of Skelly Oil Co., is president of the association and William F. Lowe secretary. The tentative program follows:

Wednesday, April 12

Operating session, 1:30 p.m.:

"Time"—President Vaiden.

"Why and Where to Build a Natural-Gasoline Plant"—Frank Matheny, superintendent natural-gas and natural-gasoline department, Phillips Petroleum Co.

"Infrared Spectrograph Analysis of Natural Gas Hydrocarbons"—H. Cary, National Technical Laboratories, Pasadena, Calif.

"Centrifugal Compressors and Their Application in Natural-Gas and Natural-Gasoline Operations"—E. O. Bennett, consultant, Houston.

Technical committee report — Chairman M. R. Church, Shell Oil Co., Inc., Houston.

Thursday, April 13

General session, 9:30 a.m.:

"The Future of Liquefied Petroleum Gases"—symposium.

Address—James E. Pew, director, Natural-Gas and Natural-Gasoline Division, Petroleum Administrator for War.

"Postwar Relationship of Refining to Natural-Gasoline Operations"—D. P. Barnard, associate director of research, Standard Oil Co. (Indiana), Whiting, Ind.

Presentation of the Hanlon Award.

High-pressure gas session, 2 p.m.:

"Unitization of Condensate Pools" — Roy L. Benoit, Ohio Oil Co., Shreveport, La.

"Operating Economies of Unitization"—Jack Flaitz, Distillate Production Corp., Houston.

"Condensate Gas Sampling" — Dr. G. G. Brown and Dr. D. L. Katz, University of Michigan.

Discussion by Kenneth Eilerts, senior chemist, U. S. Bureau of Mines, Bartlesville, Okla.

Nontechnical session, 5:30 p.m., directed by Natural Gasoline Supply Men's Association.

Friday, April 14

"Information Please"—9:30 a.m.:

Representing process companies: Gustav Egloff, Universal Oil Products Co., Chicago; John Ford, M. W. Kellogg Co., New York; A. J. L. Hutchinson, The Fluor Corp., Los Angeles.

Representing design and construction companies: M. F. Kotzebue, Gasoline Plant Construction Corp., Houston; P. M. Raigorodsky, Petroleum Engineering, Inc., Tulsa; Henry Wade, Stearns-Roger Manufacturing Co., Denver.

Representing Petroleum Administrator for War: E. D. Cummings, director of Refining Division; James E. Pew, director of Natural-Gas and Natural-Gasoline Division.

Representing the refining industry: D. P. Barnard, Standard Oil Co. of Indiana, Whiting, Ind.

Engineering consultants: Dr. G. G. Brown, University of Michigan, Ann Arbor; Dr. E. O. Bennett, Houston.

Representing production and research: R. C. Alden, Phillips Petroleum Co., Bartlesville, Okla.; Stewart Buckley, Humble Oil & Refining Co., Houston; P. S. Magruder, General Petroleum Corp., Los Angeles.

Interlocutor—D. E. Buchanan.

Screening committee: H. W. Harts, Warren Petroleum Corp., Tulsa, chairman; B. R. Carney, Shell Oil Co., Inc., Tulsa; R. G. Atkinson, Shamrock Oil & Gas Corp., Amarillo, Tex.; I. Earl Nutter, Hagy, Harrington & Marsh, Amarillo; W. W. McNeal, Jr., J. S. Abercrombie Co., Houston.

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PIPE LINES

Standard of California Completing Fresno Line

Gangs are completing Standard Oil Co. of California's new pipe line extending from Riverdale in Fresno County, California, to Coalinga and indications are that the new line will be in operation about April 1.

The project consists of 30½ miles of 6-in. and 12 miles of 4-in. line and will cost approximately $335,000. Completion of this new link will provide an outlet for production in the Helm and Riverdale fields of Fresno County.

Sun Pipe-Line Project Nearing Completion

Sun Pipe Line Co., is nearing completion of its pipe-line project in Jim Hogg and Starr counties, Southwest Texas. Fifty-one miles of 4-in. oil line connecting the East Ranch, Guerra and Weil fields with the company's tank farm in the Sun field, Starr County, have been completed, while construction has been started on 13 miles of 6-in. from the Sun field, northeastern Starr County, to Humble Pipe Line Co.'s terminal at Kelsey. The two lines will have an estimated capacity of 20,000 bbl. daily. The project is being constructed by Williams Brothers, Houston.

Two California Gas-Line Projects to Serve Goleta

Orders have been placed for 36 miles of new pipe line to serve the Goleta gas field in Santa Barbara County, California. The line will extend from Goleta to Ventura and will be built by Southern Counties Gas Co. From Ventura, the Southern California Gas Co. will lay 55 miles of 18-in. and 12 miles of 22-in. pipe to Los Angeles as soon as pipe is delivered. In addition to actual construction of this new pipe line, Pacific Lighting Co. will enlarge its Goleta compressor facilities and install a new dehydration plant. Southern Counties Gas Co. will build a new dehydration plant at Ventura and revamp its compressor station in order to handle the larger quantity expected to move southward upon completion of the new pipe line from Goleta to Ventura.

Completion of these projects will increase flexibility and permit storage of natural gas at Goleta during the summer season. This procedure has been carried on for the past several years at Goleta but the area served did not require as much gas as could be saved during the warm period. Pacific Lighting Co. purchased holdings of General Petroleum Corp. and Shell Oil Co., Inc., at Goleta several years ago and has been using the reservoir to cushion peaks and troughs in demand.

Condemnation for Gas-Line Easement Draws Protest

AUSTIN, Tex.—Texas landowners in Harris, Waller and Fort Bend counties last week appealed to Gov. Coke R. Stevenson for advice and assistance in condemnation proceedings instituted in behalf of the Tennessee Gas & Transmission Co. which is building a natural-gas pipe line from South Texas to West Virginia.

The governor asserted he could not understand how easements for the line could be condemned without giving property owners prior notice.

He spoke after Francis Young, Waller County landowner, personally reported to the governor he had received notice of condemnation by federal District Court in Houston.

Young told the governor he received court order after he signed an easement agreement with a representative of the pipe-line company who gave him a check for $246. The landowner said payment of the check was stopped after he had deposited it in a Brookshire bank. Then, without previous notice, he received the court condemnation order, Young related.

Young said that he himself would not oppose the government action since apparently the Government had decided the pipe line was a wartime necessity, but that he "might do something about it after the war."

Louisiana Commission Protests Memphis Gas Line

WASHINGTON. — Opposition from coal, mine and railroads interests and from the Louisiana Public Service Commission arose here last week at the Federal Power Commission hearing on an application by the Memphis Natural Gas Co., Memphis, Tenn., for

a 61-mile extension to its natural-gas pipe line.

A proposed 18-in. gas line from Monroe, La., to Memphis is a "potential threat" of jobs of coal miners and railroad workers of the district, Thomas J. McGrath, counsel for six organizations opposing the addition, told the commission.

Limited reserves of natural gas in Louisiana are being drawn out of the state at an "alarming rate" the commission was told by P. A. Frye, of Baton Rouge, La., secretary of the Louisiana commission.

Stanolind to Start Runs From West Texas Fields

Deliveries of crude oil will start within the next few days through Stanolind Pipe Line Co.'s new 16-in. line from the Slaughter-Wasson fields in West Texas to the Drumright-Cushing area of Oklahoma. Welding operations were completed late last week. The western 70 miles of the line contains about 88,000 bbl. of line-fill oil, the result of the operator's decision to use completed portions of the line to reduce the requirements for building additional field storage.

Allowable production in the Slaughter-Wasson area was increased for April by Texas Railroad Commission to provide the necessary crude oil for operation of the Stanolind line.

Current plans call for shipment of approximately 55,000 bbl. daily of West Texas crude through the Stanolind line. About 35,000 bbl. of the scheduled daily throughput will be transshipped at Cushing, Okla., where Stanolind will build a loading rack, to East Coast refineries. The Cushing rack will displace Atlantic Refining Co.'s 25,000-bbl. rack at Midland, Tex., leaving a net increase of around 30,000 bbl. daily for West Texas crude-oil requirements. Shortages of tank cars, however, have prevented capacity operation of the Midland rack. Turn around of tank cars operating between Cushing and the East Coast will be shortened 4 days compared with the time required when loading at Midland. This saving in time will, it is believed, permit the available number of cars to handle substantially larger volumes of crude from Cushing. The Petroleum Administration for War, it was reported this week, expects to arrange for shipments of 35,000 bbl. daily by tank cars from Cushing to District 1.

Refineries of Standard Oil Co. (Indiana) will take 14,000 bbl. daily from the Stanolind line and an additional 6,500 bbl. daily will be diverted to other District 2 refineries or stored temporarily until plant operators complete facilities for processing sour crude.

The Stanolind line has a designed capacity of 65,000 bbl. daily which is expected to be fully utilized in May and subsequent summer months.

Because of the time lag in starting tank-car shipments from Cushing the indications are that movement through the line in April will be about 30,000 bbl. daily. Representatives of the Stanolind companies at Austin, Tex., last week asked the Railroad Commission for 30,000 bbl. daily in the Slaughter-Wasson area during April and an additional 35,000 bbl. per day by May 1. The loading rack at Cushing, it was understood, will be completed by May 1, accounting for the expanded demand 5 weeks hence.

Magnolia Pipe Line Co.'s new 12-in. line from Midland to Corsicana, Tex., will operate at capacity of 42,000 bbl. daily during April, if nominations by the company at the Railroad Commission hearing are fully honored. The company plans delivery of 27,000 bbl. daily to Magnolia Petroleum Co.'s Beaumont, Tex., refinery; 10,000 bbl. will be diverted to the War Emergency Pipelines, Inc. 24-in. system at Longview, Tex., and 5,000 bbl. daily will be handled for account of The Texas Co. The Magnolia line has been in operation for about 2 weeks.

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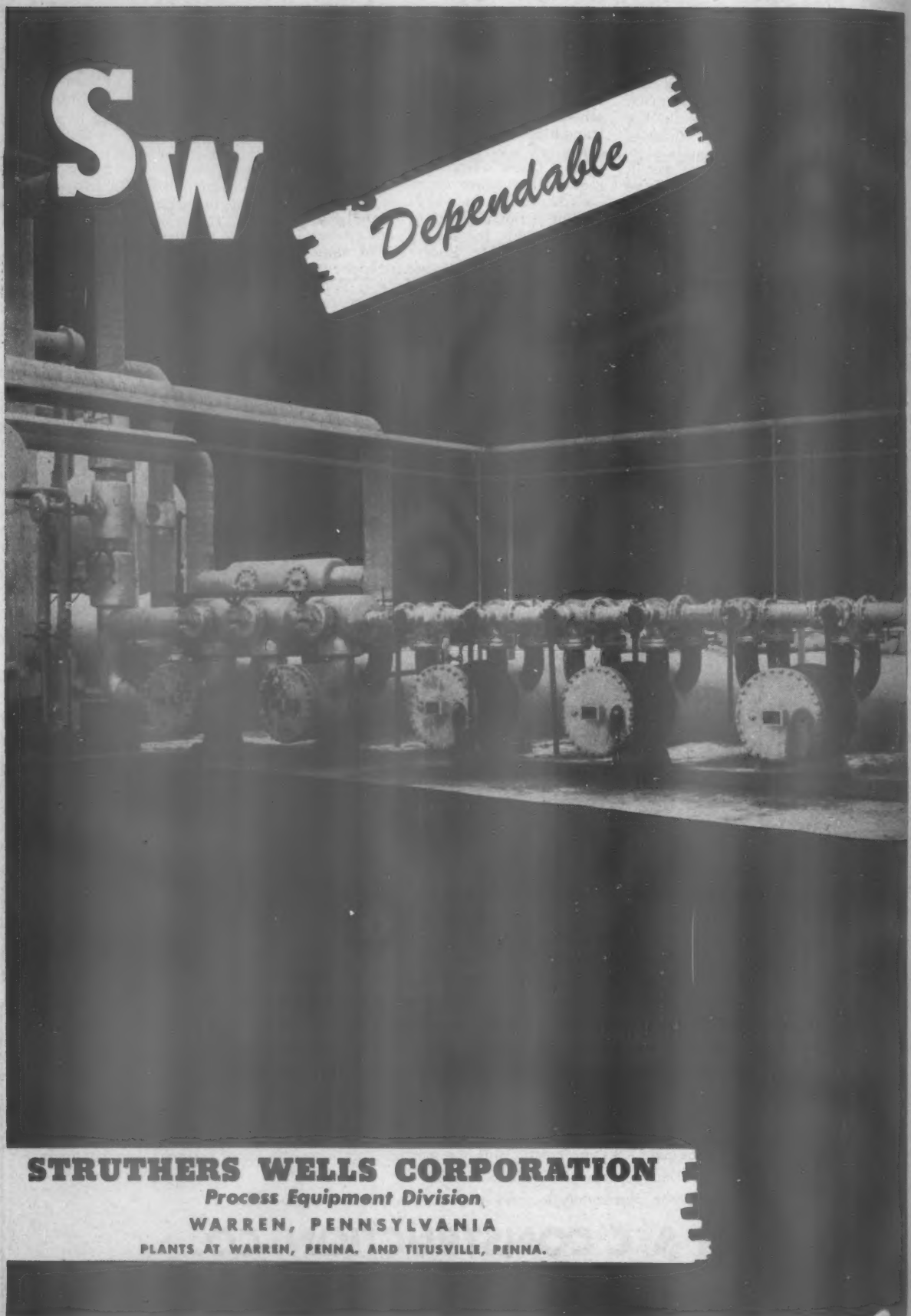
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Exploration and Drilling

Week's Highlights

ALTHOUGH March 15 did not bring forth the promised relaxation of spacing regulations in Illinois producers were very much interested in reports that the Petroleum Administration for War was contemplating stepping its 1944 goal of completed wells up from 24,000 to perhaps 30,000. A 25 per cent increase in well completions would materially aid in holding present production rates but its over-all effect, according to operators, will depend on other considerations.

Opinions differ on the amount of inside drilling in developed areas that will take place, if spacing regulations are substantially relaxed. Some operators maintain that at the present price of oil, many of the fields drilled in the past 2 years under wide spacing, will have few additional inside locations drilled, regardless of liberalized spacing. Others say this holds true only of some areas, and particularly of edge wells between the outside dry holes and the present producers, where relaxed spacing regulations permit only the choice of taking a 50-50 chance on a light well or another dry hole.

Operators who are reworking old areas, searching for small fields overlooked in the first play, say that modified-spacing regulations will help in development of the fields they are now finding because they usually cover only a small area. But all of them stress the fact that along with relaxing of spacing regulations, there must be additional manpower. Operators interested in drilling in areas that are either relatively undeveloped, such as Mississippi and Alabama, and those interested in more work in West Texas, wonder whether transportation outlets will be available to match the production that can be found by drilling more wells.

Major companies with interests in many areas, particularly those with refineries in District 2 that are short of crude, say they have a problem of balancing any additional steel for wells among the areas in which (1) the most reserves can be proven, but in which transportation outlets may not be sufficient; or (2) smaller reserves will be proven, but transportation outlets are ample, and the oil can be made available to the refineries which need it badly.

Solid line charts current weekly completions

COMPLETIONS IN ALL FIELDS . . .

(Week Ended March 18, 1944)

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1944	1943
N. Y., Penna., W. Va.	55	7	17	79	148,252	694	632
Ohio	4	8	7	19	55,600	195	195
Indiana	1	0	2	3	7,154	50	56
Kentucky	5	2	5	12	23,591	122	43
Illinois	14	1	14	29	73,100	351	384
Michigan	3	0	3	6	15,160	107	83
Kansas	13	2	19	34	117,878	342	271
Nebraska	0	0	0	0	0	8	4
Missouri-Iowa	1	0	0	1	480	1	3
Oklahoma	14	1	15	30	107,740	304	231
Texas:							
North Central Texas	25	0	13	38	94,766	267	241
West Texas	12	0	3	15	79,024	288	174
Texas Panhandle	3	0	1	4	11,349	28	40
Eastern Texas	1	0	2	3	15,956	63	52
Texas Gulf Coast	12	1	11	24	154,768	114	81
Southwest Texas	2	0	17	19	91,906	206	176
Total Texas	55	1	47	103	447,767	967	764
Louisiana:							
North Louisiana	3	0	4	7	35,963	52	60
Louisiana Gulf Coast	12	0	5	17	148,470	88	75
Total Louisiana	15	0	9	24	184,433	140	135
Arkansas	6	0	0	6	38,052	46	47
Mississippi and Southeast	0	0	1	1	4,002	28	11
Montana	6	0	0	6	15,958	45	31
Wyoming	8	0	1	9	41,398	30	25
Colorado-Utah	1	0	0	1	6,794	8	2
New Mexico	5	0	2	7	26,012	86	44
California	39	2	3	44	158,736	373	211
Total United States	245	24	145	414	1,470,107	3,900	3,172
Total previous week	186	36	88	310			
Week ending Mar. 20, 1943	141	28	88	258			

EASTERN TEXAS

Van Zandt County Given Travis Peak Test

DALLAS.—The Texas Co. 1 J. M. Easley, 660 ft. from northeast and northwest of 71.5-acre tract in N. T. Dickerson Survey, 3 miles south by east of Jackson, is to be a new Travis Peak wildcat test for southwest Van Zandt County. Several wells have been drilled to the Woodbine in this vicinity, but no wells have gone below 5,000 ft.

Wood County.—Gulf Oil Corp. 1 Brewer, wildcat southwest of Winnsboro which opened a new Rodessa pay pool, is perforating casing to complete from 7,984-8,016 ft. Shell Oil Co., Inc. 1 Whatley, Rodessa pay discovery on southeast flank of Manziel pool, quit flowing and operators were running pressure bomb to try to revive.

Limestone County.—W. J. Gourley et al 1 Ethel Barron, wildcat south of the Barron production west of Groesbeck, topped Pettit zone at 5,745 ft., and cored to 5,800 ft., recovering 5 ft. of hard lime, bleeding some oil, and was coring ahead.

Derrick has been erected for the wildcat in northern Lamar County being drilled by Cosden Petroleum Co. 1 W. T. Adams, 5,000-ft. test in the J. R. Gibson Survey. A shallow test is to be drilled in Robertson County, 2 miles east by north of Franklin. It will be William L. Clary and J. S. Fabriquse 1 W. W. Sandifer, M. Grande Survey. In Harrison County, Hassie Hunt trustee 1 Bailey and Martin will be a Travis Peak test in the J. J. Martin Survey.

EAST TEXAS WILDCAT COMPLETION

Leon County: Iseman & Gieski 1 D. H. Morrill, 1,200 ft. from SW, midway between NW and SE, 56-ac. tract, Clark Sur., ½ mi. SW Buffalo, dry at TD 2,314 ft.

TEXAS GULF COAST

Cottonwood Field Slated For More Development

HOUSTON, Tex.—Additional development was slated to be started in the new Cottonwood field, Liberty County, following the completion of William Helis 1 Willis as the second producer for the structure. Production was obtained by perforating casing opposite the Wilcox sand at 7,747-53 ft., and on a 2-hour drill-stem test the well flowed at the rate of 100 bbl. daily through a ¼-in. choke on bottom and a ⅛-in. choke on top. This test is in the T&NO Survey 28, a southeast offset to the discovery well.

In the Winnie-Stowell area, Chambers County, Sun Oil Co. 1 Daugherty pool which has been showing for a pool opener, is now shut in and will be worked over at a later date. Total depth is 9,519 ft.

Exploration along the upper Texas Gulf Coast sector of the Wilcox trend is showing a steady increase and a recent check of activity showed a total of 20 locations, drilling or scheduled to be drilled.

Northwest of Port Acres, Jeffers County, Glenn H. McCarthy 2 J. M. Hebert, William Segler Survey, flowed 103 bbl. of salt water and 1 bbl. of distillate daily through a ¼-in. choke from perforated casing at 10,057-63 ft. This is the second test on the structure, being located just southwest of 1 Hebert which blew out several months ago and had to be abandoned.

TEXAS GULF COAST WILDCAT COMPLETIONS

San Jacinto County: Stanolind Oil & Gas Co. 1 Roberts, 3 mi. southwest of Shepherd, dry at 8,519 ft.

Trinity County: Navarro Oil Co. 1 Bolton, 3 mi. southeast of Saron, dry at 6,287 ft.

Tyler County: Humble I Denman Kountze, 1 mi. northeast of Rockland, dry at 8,105 ft.

LOUISIANA GULF

Rosedale Wildcat Prepares To Drill Deeper

NEW ORLEANS, La.—Southwestern Oil & Gas Co. 1 Schwing, a semi-wildcat in the Rosedale field, Iberville Parish, was attracting attention as it prepared to drill deeper below 10,057 ft. An electrical survey logged broken sand showing oil at 9,230-45 ft., 9,380-9,405 ft., and 9,658-72 ft. The well is about 1 mile west of the discovery well and is thought to have cut a fault at 8,300 ft., which places it about 500 ft. structurally high correlated with an old hole drilled by Congo Oil Co. on the Dregus lease.

Amerada 1 Kedder, located in the new Arnaudville field, St. Martin Parish is slated to be completed as a gas-distillate producer. With the hole bottomed at 10,643 ft., casing was perforated at 10,160-176 ft. and the well flowed 23 bbl. of distillate and 1,311,000 cu. ft. of gas per day through a ⅛-in. choke.

Union Oil Co. of California opened gas-distillate production in the Bear Creek area, Beauregard Parish, with the completion of 1 Edgewood Land & Logging Co. in 25-6s-10w Total depth is 6,900 ft. in salt water sand with production from the Cockfield sand opposite casing at 6,767-70 ft. Initial production was 40 bbl. of 58-gravity distillate and 600,000 cu. ft. of gas flowing through a ⅛-in. choke. This prospect is located about 6 miles northeast of the town of DeQuincy and about 22 miles east of the Bancroft field which also produces from the Cockfield. It is also 4 miles from the discovery well on the Bear Creek field where additional development was being started by Phillips Petroleum Co. on the Krouse-Managan lease in 28-6s-92, a farmout from Humble Oil & Refining Co.

On the northwest flank of the Jefferson Island salt dome field, Vermilion Parish, Atlantic Refining Co. is moving in material for a 11,000-ft. test in 62-12s-5e, about 3,500 ft. northwest of production.

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 18 crude oil	Distillate, allied products	Mar. PAW quota all oils	Mar. 11 crude oil
Arkansas	79,700	5,000	81,700	79,200
California	827,750	47,200	880,600	822,250
Colorado	7,640	.....	7,000	8,140
Eastern	71,800	8,900	81,100	72,250
Illinois	208,810	13,000	228,000	227,650
Indiana	13,650	.....	13,600	13,550
Kansas	284,150	6,000	291,000	259,500
Kentucky	24,100	2,800	26,800	23,100
Louisiana	360,150	23,000	375,700	360,500
North Louisiana	76,200	.....	.....	76,550
Louisiana Gulf	283,950	.....	.....	283,950
Michigan	53,750	300	52,300	52,300
Mississippi	38,700	.....	46,000	42,950
Montana	23,860	300	24,300	23,865
Nebraska	1,300	.....	1,000	1,325
New Mexico	112,550	4,900	116,600	112,550
Oklahoma	329,400	27,000	355,000	328,300
Texas	1,863,450	127,000	1,965,000	1,863,350
East Texas	365,400	.....	.....	365,100
West Texas	340,600	.....	.....	340,900
North Central Texas	142,700	.....	.....	142,600
East Central Texas	116,500	.....	.....	116,600
Texas Panhandle	92,850	.....	.....	92,850
Texas Gulf	710,750	.....	.....	710,650
Southwest Texas	94,650	.....	.....	94,650
Wyoming	90,830	7,200	100,200	92,900
Total United States	4,391,590	277,600	4,645,900	4,383,680

Total production January 1-March 18, 1944 ..... 342,781,715 bbl.
Same period last year ..... 298,041,835 bbl.

CALIFORNIA

Sand Showing May Open New Area at Buena Vista

LOS ANGELES.—Of outstanding importance is the discovery of Standard Oil Co. of California on the United anticline in the Buena Vista Hills field of Kern County as the new zone found in the company's 54-27-B in 27-31s-23e may open up considerable acreage for development. The discovery was found at 4,273-4,303 ft. and this 30 ft. of oil sand was followed by 60 ft. additional oil sand at 4,376-4,436 ft. making a total of 90 ft. in an interval of 163 ft. Two formation tests yielded gas and clean gassy oil. The hole has been drilled ahead to 4,645 ft. and casing has been landed preparatory to an early production test.

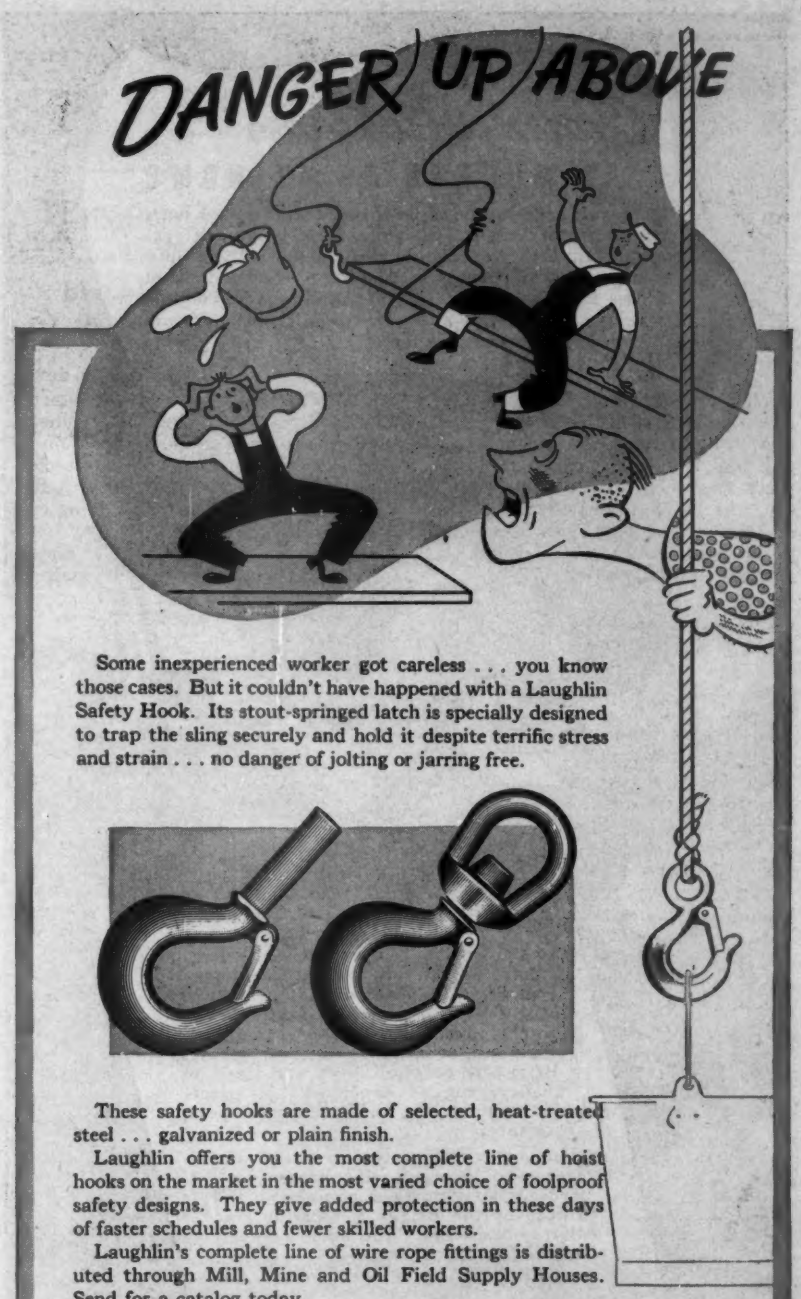
The Buena Vista Hills field has not received much consideration since Honolulu Oil Corp. drilled a dry hole on the Honolulu anticline and abandoned work at 14,622 ft. Buena Vista Hills anticline contains approximately 15,000 acres about equally divided between the United anticline and the Honolulu anticline which means there is a strong possibility that the potentially productive acreage affected by Standard's discovery may exceed 5,000 acres. Buena Vista Hills field is located within Naval Reserve No. 2 but over half of the land involved is owned in fee by a number of operators.

In the Polvadero district of Fresno County between the Coalinga Nose field and Kettleman North Dome, Standard Oil Co. of California has landed pipe in 1-A Bordieu in 1-21s-16e and has run in a 4¾-in. perforated liner. This hole is down 10,868 ft. and top of the Hondo is placed at 10,859 ft.

Edwin and Harold Pauley have temporarily suspended work on 1 Loftus in the El Segundo district of Los Angeles Basin and will rig up pumping equipment. This wildcat drilled from a surface location on the Loftus property but bottomed beneath the Hyperion sewer farm failed to result in a natural flow but has definitely proved up the existence of an oil sand. Pauley's wildcat, too, has a fish in the bottom of the hole so that the lower part of the oil sand may be blanked off. It is generally conceded that Pauley has proved up the existence of a new oil field between El Segundo and Playa Del Rey which supports the opinion of geologists several years ago that a new field could be expected in this area.

CALIFORNIA WILDCAT COMPLETION

Malton wildcat district, Tehama County: General Petroleum Corp. 1 Dolan, 33-23n-3w, abandoned as not productive, TD 2,873 ft., several form. tests 2,850-73 ft., were unsuccessful, hole caved.



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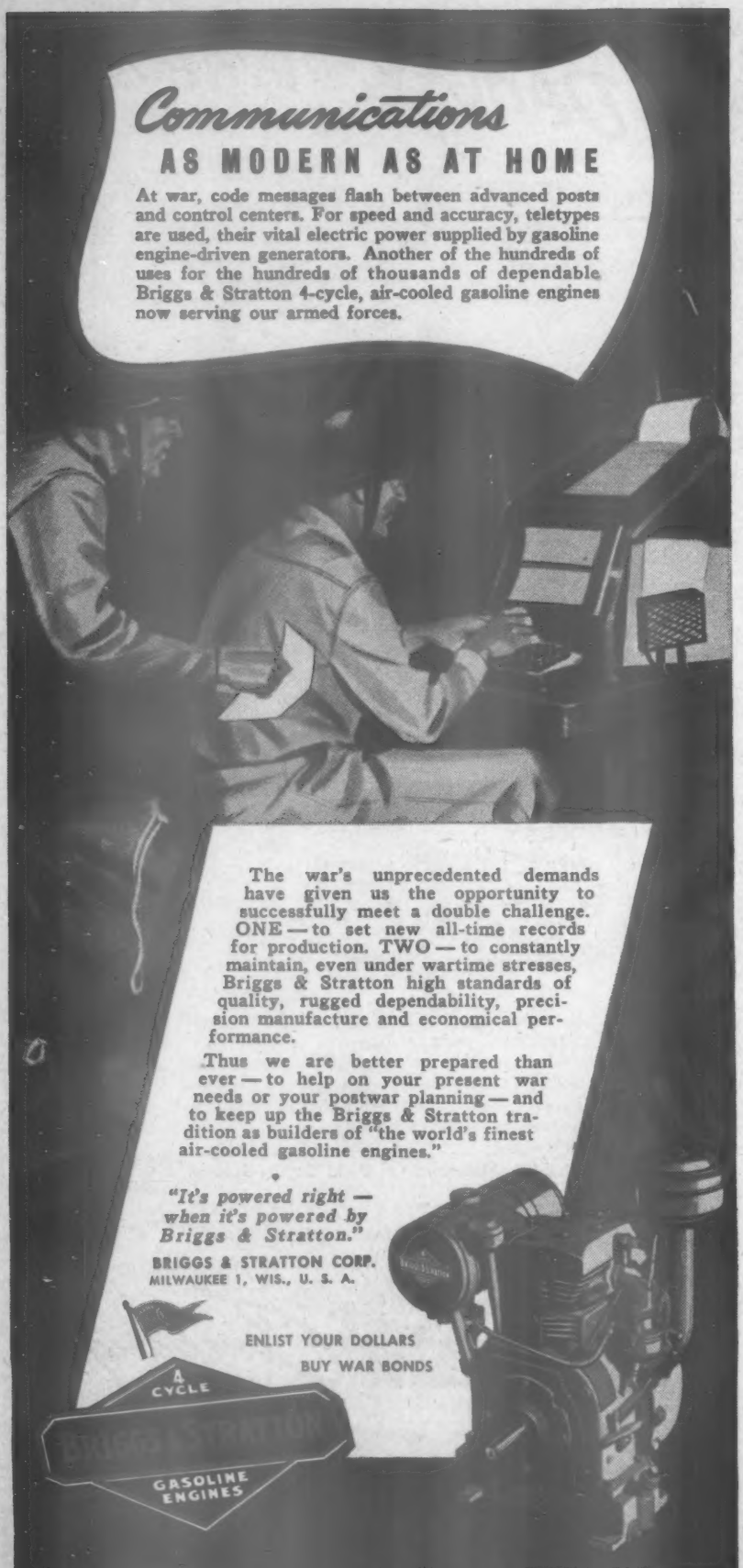
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N. CENTRAL TEXAS

Bellevue Pool of Clay County Extended

WICHITA FALLS, Tex.—The Bellevue pool of southeastern Clay County, discovered at Shell Oil Co., Inc. 1 R. F. Wynn, C. Rooney Survey, 4 miles west of Bellevue, has been extended one location in two directions. West of the discovery, Shell Oil Co., Inc. 1 Harris, which topped Mississippi lime pay at 6,214 ft., drilled to total depth 6,299 ft., and on unofficial test flowed 316 bbl. in 2 hours through tubing after a mud-acid wash of 200 gal. The southeast offset to the discovery, Sinclair Prairie Oil Co. 1 Emma Spikes, J. Cook Survey, also indicated a good well in flowing 147 bbl. per hour through 1-in. choke on tubing from Mississippi lime pay topped at 6,161 ft., total depth 6,250 ft. This operator has staked location for 2 Spikes, 1,120 ft. west of No. 1, which will be a south offset to the Shell Harris well.

Jack County.—Two new wells were added to the McDonald pool, one of which was a pumper. Champlin Refining Co. 3 Tibbs, on north edge of the pool, pumped 102 bbl. per day from 3,483-86 ft., and Standard Oil Co. of Texas and Hanlon-Buchanan 1 Oliver Loving, J. B. Irvine Survey, flowed 52.8 bbl. plus 9.6 per cent water in 6 hours through ½-in. choke on tubing.

Montague County.—Continental Oil Co. 1-B H. C. Gadberry, T. R. Willis Survey, and same operator's 1 J. B. Lewis, Section 57, ET Ry. Survey, were two new producers for the Hildreth pool.

NORTH CENTRAL TEXAS WILDCAT COMPLETIONS

Archer County: Carl Childs 1 J. D. Bell, 200 ft. from N, 600 ft. from E, 206-ac. tract, Sec. 14, Blk. 5, Clark & Plumb subd., dry at TD 1,135 ft.

C. H. Featherstone 1 L. Kinder, 300 ft. from S and W, Sec. 112, Blk. 5, Clark & Plumb subd., dry at TD 1,303 ft.

Fortex Oil 1 C. L. Abercrombie, 1,000 ft. from N, 1,200 ft. from W, Sec. 98 and 97, 210-ac. tract, Blk. 4, Clark & Plumb subd., dry at TD 1,255 ft.

Cooke County: Chester A. Martin 1 J. A. Wylie, 480 ft. from E, 150 ft. from S, 20-ac. tract, Thos. Cooke Sur., dry at TD 1,459 ft.

Wichita County: Oscar Donley 1 Mrs. J. L. Bostic, 850 ft. from N, 330 ft. from W, Blk. 3, Henry Hastie Sur., dry at TD 1,503 ft.

Young County: Paul Atchley 1 Ernest Gilbert, 200 ft. from S and E, 40-ac. lease, Sec. 221, TE&L Sur., dry at TD 1,007 ft.

WEST CENTRAL TEXAS

ABILENE, Tex.—Second well for the new pool south of Novice, Coleman County, has been completed by Hunter and Hunter. It is the firm's 1-B C. C. Williams, northwest offset to the discovery from the Gray sand, and flowed 110 bbl. per day through ¼-in. choke from pay topped at 3,768 ft. Total depth is 3,799 ft.

MICHIGAN

Field Activity Restricted; Commission Order Upheld

SAGINAW, Mich. — Production of wells in Michigan's Reed City field will continue to be restricted to 175 bbl. per day from wells drilled on 40-acre tracts and to 125 bbl. on 20-acre units. The state Conservation Commission has upheld P. J. Hoffmaster, state supervisor of wells, who ordered the proration cut last December. In backing his action, the commission rejected the first appeal to a supervisor's ruling ever presented to the commission. The appeal was signed by seven major oil companies.

Field activities continue restricted. In the past week only six drilling operations were completed, including a Newaygo well drilled by Pure Oil Co. for initial flow of 888 bbl. a day. Others produced in Allegan and Bay counties. Two of three dry holes were wildcat tests.

Drilling permits for the year increased to 98 as the conservation commission approved nine applications. The permits are for two locations in Allegan, two in Arenac, one each in Kalamazoo, Mecosta, Newaygo, St. Clair and Van Buren counties.

MICHIGAN WILDCAT COMPLETIONS

Allegan County, Martin Township: James J. McGerry, tr., 1 Conrad Haveman, SE NW NE 30-2n-11w, dry, TD 1,639 ft.

Gratiot County, Pine River Township: Charles W. Teater 1 Church and Ring, NE SW NE 9-12n-3w, dry, TD 1,250 ft.

APPALACHIAN FIELDS

Oriskany Test Slated In Fayette County

PITTSBURGH.—On Chestnut Ridge in Wharton Township, Fayette County, New Penn Development Co. et al have staked a location for an Oriskany test on the Piedmont Coal Co. tract, located 664 ft. east of the Heyn (Summit Hotel) farm line and 200 ft. south of U.S. Route 40. It is approximately 1,800 ft. east of the Summit crossroads and will be the most easterly test.

At Ambridge in Harmony Township, Beaver County, Pennsylvania, National Supply Co. 1 fee wildcat is now drilling in the Onondaga chert.

In North Strabane Township, Washington County, Pennsylvania, Young et al have a fair gas well as a test on the Frank Hullock. The gage is 700,000 cu. ft. with the Big Injun topped at 1,570 ft.; gas 1,574-76 ft., total depth 1,580 ft.

In Union district, Kanawha County, West Virginia, Columbian Carbon Co. completed a large gas well in a test on the A. O. Carney in the Big lime topped at 1,465 ft. with an open flow of 5,034,000 cu. ft. Total depth 1,517 ft.

CANADIAN FIELDS

Canadian Exploration Approaches Montana Line

CHATHAM, Ont.—British-American Oil Co. of Calgary has located a wildcat test in the southern plains area of Alberta, in LSD 8, 30-2-16w4. Location is just south of Milk River, 12 miles north of the Montana boundary, and east of the Red Coulee field. Rig is being moved in by S. W. S. Drilling Co. of Edmonton.

Aldersyde. — On the High River-Aldersyde structure east of Turner Valley, New Ranchmen's - Snider 1, LSD 16, 34-19-29w4, bottomed in the Madison at 7,782 ft., has cemented to shut off water in the lower 4 ft. On an initial test at 7,865-92 ft., fluid rose 780 ft., representing 330 ft. of 38.6-gravity crude and 450 ft. salt water.

Turner Valley. — On the east flank of the North Turner Valley extension, Northend Petroleum 1, LSD 12, 9-21-

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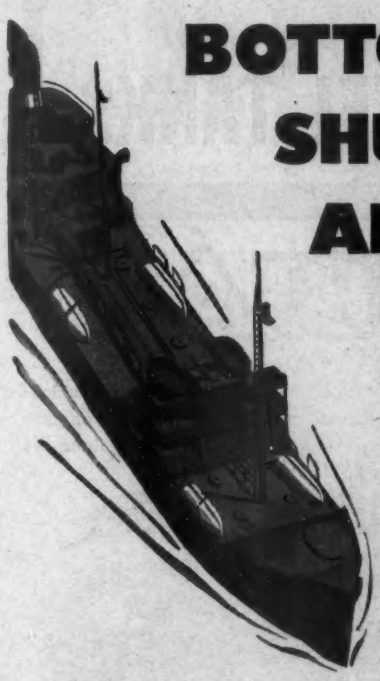

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3w5, finished at 9,612 ft. with Madison at 8,929 ft., made 471 bbl. on a 24-hour test and is waiting allowable. A result of the completion has been shifting of the location of Imperial-Hudson Bay 17 from LSD 12, 8-21-3w5 to LSD 16, offsetting Northend 1 to the northwest.

Gaspe.—In the Gaspe Peninsula of Quebec, Continental Petroleum, Ltd., 2, started January 14, is below 1,350 ft., after striking some gas in a fractured zone at 950 ft. Location is 113 ft. due east of Petroleum Oil Trust 20, drilled in 1896, which encountered oil at 2,058 ft. and is still flowing a little high-gravity crude. Plans have been made to carry C.P.L. 2 to 2,500 ft., coring from 1,950 ft.

PERMIAN BASIN

Winkler County Wildcat Makes Flow From Clear Fork

MIDLAND, Tex.—Stanolind Oil & Gas Co. 1 Sealy Smith Foundation, SW SW Section 50, Block A, G&MMB&A Survey, southern Winkler County, opening a new Clear Fork lime pool, flowed 365 bbl. oil in 9 hours, after treating the pay section at 6,170-6,250 ft. with 3,000 gal. acid. Total depth of the new strike is 6,305 ft. in lime. In the Keystone-Ellenburger pool, Sinclair Prairie Oil Co. 4 J. B. Walton, SE SE Section 20, Block 77, Public School Land, total depth 9,682 ft., flowed 1,092 bbl. oil in 17 hours through ½-in. choke. This operator has staked 5-A Walton one location west of the above well. Richardson & Bass 2 Walton, SE SW¼ Section 1, Block B-2, Public School Land, extended the Keystone-Holt pool ½ mile west when it flowed 33 bbl. per hour, Holt pay topped at 4,731 ft., total depth 4,772 ft. This is an old well drilled deeper. Magnolia Petroleum Co. 21 State-Walton, Kermit-Ellenburger pool, flowed 165 bbl. in 24 hours through ¼-in. choke, after treating with 200 gal. mud-acid. Sun Oil Co. has entered the field with a location for 1 Wheeler, NE SE Section 13, Block B-7, Public School Land, southwest offset to the discovery.

Pecos County.—Humble Oil & Refining Co. 1 Smith, which was moved from SW NE Section 12, Block 145, to Section 2, Block 145, when the Standard well first showed gas, will be drilled in its original location in Section 12 since the Standard well proved dry.

Crane County.—An interesting wildcat, to test the Ellenburger or 7,500 ft., will be Magnolia Petroleum Co. 1 Mary Butler, SE N½ S½ Section 6, Block 1, H&TC Ry. Survey, 7½ miles due east of Ellenburger production in the Abell pool.

WEST TEXAS WILDCAT COMPLETIONS

Gaines County: C. U. Bay and Carl B. King 2 Blair, NE SE Sec. 39, Blk. AX, PSL Sur., deep test on E side Wasson pool, elev. 3,518 ft., SSO 6,960-75 ft., 8,725-55 ft., 7,905-25 ft., dry at TD 8,096 ft.

Glasscock County: McElroy Ranch Co. 1 B. A. Keathley, SE SW Sec. 40, Blk. 34-3s, T&P Ry. Sur., dry at TD 3,225 ft.

Yoakum County: Neville G. Penrose, Inc. 1 A. M. Brownfield, 660 ft. from N and E. Sec. 563, Blk. D, J. H. Gibson Sur., elev. 3,550 ft., brown lime 4,470 ft., sol. lime 5,010 ft., dry at TD 5,501 ft.

SOUTHEAST NEW MEXICO

HOBBS, N. M.—R. R. Woolley 5-A Arnold, SE SE Section 22-17s-30e, Grayburg pool, Eddy County, was completed for 80 bbl. per day after being shot with 100 qt. nitroglycerin in pay from 1,940-65 ft. to give another shallow pay to the pool. This well is located 2½ miles due west of the shallow area opened last year by Fren Oil Co., and indicated a possible streak of shallow pay along the south side of the old Grayburg pool proper. Offset wells produce from a lime pay at about 3,150 ft. Before shot the well was estimated at 40 bbl.

SOUTHEAST NEW MEXICO WILDCAT COMPLETIONS

Eddy County: S. P. Yates 3 Evans, NW NE 5-17s-30e, elev. 3,714 ft., SO 1,254-64 ft., 2,280 ft., SO&G 2,684-95 ft., 2,764-71 ft., dry at TD 6,587 ft.

PANHANDLE

AMARILLO, Tex.—The wildcat of Pure Oil Co. 1 Sneed Ranch, Dallam County, was drilling below 3,802 ft. in lime.

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ROCKY MOUNTAIN

Wyoming Wildcats Are Prospective Pool Openers

DENVER.—Two Wyoming wildcats nearing completion are giving favorable indications of opening two new black-oil pools. One is Broderick & Gordon 1 Christensen, NE SE 6-44n-98w, on the Wagonhound structure in Hot Springs County, 4 miles northwest of the Hamilton field, which produces from the Embar and Tensleep. In a drill-stem test at 4,261-4,306 ft., open 1 hour, it showed 210 ft. of cut mud, 180 ft. of cut oil and 540 ft. of pipe-line oil. It had about 60 ft. of saturated Embar and is drilling ahead to test the Tensleep. It reached the top of the Tensleep at approximately 4,641 ft., but has not yet run pipe before drilling in. Wagonhound is an unfaulted anticline with 400 ft. of closure. Only one test previously has been drilled and it stopped in the Embar.

The other interesting wildcat is British-American Oil Producing Co. 2-C Tribal, NE SE 31-4n-1w, Steamboat Butte field, Fremont County. It is northwest of thfee wells, including the discovery, all in the Sundance. This is the first test of the structure to the Tensleep. It is bottomed at 7,034 ft., with the 5½-in. at 6,772 ft. The top of the Tensleep was at 6,771 ft. The cores from the Tensleep showed saturation but the first drill-stem test was unsuccessful. Casing then was run preliminary to testing.

South Elk Basin test.—Carter Oil Co. 2 Johnson, NE NE NW 8-57n-99w, a key well at the south end of the Elk Basin field, which will mean an important extension in that direction, is showing for a producer in the Embar horizon and is drilling ahead to the Tensleep. It had the top of the Embar at 5,596 ft., and stopped at 5,639 ft. for a drill-stem test. With tester open 30 minutes it showed 2,070 ft. of fluid, of which 1,800 ft. was pipe-line oil. The location is a mile south of MacKinnie Oil & Drilling Co. 2 Northern Pacific, completed last August for 1,500 bbl. in the Tensleep.

Arizona test hits granite.—Union Oil Co. of California 1 New Mexico-Arizona Land Co., SW SW NE 34-15n-19e, Holbrook district, Navajo County, Arizona, joint with Continental Oil Co., stopped in granite at 3,607 ft., and will plug back to test slight saturation encountered at 1,700-80 ft. on the way down.

Montana wildcat testing.—Northern Ordnance, Inc., 1 Northern Pacific, NE SW 19-9n-27e, Gage dome, Musselshell County, which is testing the Amsden sand, topped at 6,124 ft., shot the sand at 6,135-57 ft. with 80 qt., and fluid rose 800 ft., there being no native water. Some gas accompanied the oil. It is rigging up cable tools to shoot again with 100 qt. Location is 3½ miles southwest of the same company's discovery last year and 4½ miles south of 1 Darr, the second well drilled, which was completed last January for 358 bbl. natural first 24 hours. Fourth well in 14-9-26 is drilling and location has been made for the fifth in 22-9-26. Discovery was on a farmout from Carter Oil Co., Northern Ordnance subsequently acquiring the entire block.

WYOMING WILDCAT COMPLETION

Little Buffalo Basin, Park County: Stanolind Oil & Gas Co. 1 Unit, SW SW NE 34-48n-100w, TD 5,776 ft., 200 ft. in Madison water in sand, Tensleep dry at 5,042-5,326 ft.

ILLINOIS

Markham City North Pool Has Week's Best Well

CENTRALIA, Ill.—Fourteen oil wells, 14 dry holes and a gas well were completed in the past week in review in Illinois. Initial production of 1,271 bbl. averaged 90 bbl. per well. The largest well of the week was Central Pipe Line Co. 1 Holloway, C SE NE 13-2s-4e, in the Markham City north pool in Jefferson County. It pumped and flowed 475 bbl. in 18 hours and then pumped

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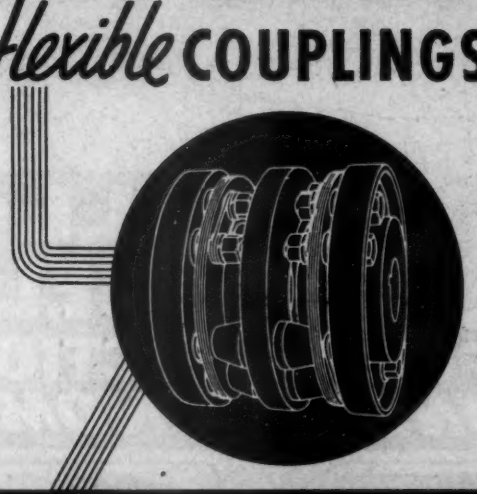

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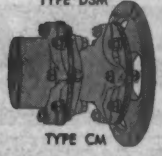
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and flowed 550 bbl. in 24 hours from McClosky lime at 3,046-58 ft., which had been acidized.

A pool was opened in Saline County by Jarvis & Marcell, but the initial production was only 7 bbl. of oil, swabbed. No. 1 Sisk, SE NW NE 15-10s-6e, found pay in Waltersburg sand at 1,498-1,508 ft., which was given a 30-qt. shot. The location is about 7 miles south of Harrisburg.

Thirty-four new operations were reported during the week including 10 wildcats; The Texas 1 Kemmer, NW NE SE 34-4n-6e, Clay County; Pure 1 J. P. Molt-A, SW SE NE 31-1n-8e, Wayne County; Winkler & Powers 1 Garrison, NE NW NW 18-3s-7e, Wayne County; Porter & Slaughter 1 Seiler, SE NE SW 35-1s-13w, Wabash County; Kingwood 1 Danks, SE SE SE 25-6n-4e, and Luttrell et al 1 Wallace, NE NW NW 24-6n-5e, Effingham County; The Texas 1 Enloe, SE SE NW 6-4n-2w, Bond County; Magnolia 1 Hall, NW NE NW 14-5s-3e, Franklin County; Superior 1 Sarah Pulley et al, SE NE NW 13-9s-3e, Williamson County.

ILLINOIS WILDCAT COMPLETIONS

Gallatin County: George F. Carroll 1 Hughes, SE NW SW 9-8s-10e, dry at 2,118 ft.

Hancock County: Herndon Drilling Co. 1 Tassey, C SE SW 17-3n-7w of 4th P.M., dry at 3,024 ft.

Jefferson County: Magnolia 1 C. C. DeWitt, NW NW NW 16-2s-3e, dry at 2,920 ft. Tar Springs 2,171 ft., Cypress 2,456 ft., Benoist 2,622 ft., Aux Vases 2,881 ft., McClosky, 2,817 ft.

Pike County: J. G. Gill 1 Tettsworth, NE SW SE 13-5s-6w of the 4th P.M., dry at 600 ft. Burlington 45 ft., Kinderhook 155 ft., Silurian 315 ft., Maquoketa 345 ft., Trinity 522 ft.

Saline County: Ohio 1 Land-Gibbons, SE SW NW 33-10s-7e, dry at 930 ft. Hardinsburg 612 ft., Aux Vases 687 ft., Fredonia 687 ft., St. Louis 860 ft.

Jarvis & Marcell 1 Sisk, SE SW NE 15-10s-6e, Waltersburg sand 1,498-1,508 ft., shot, swabbed 7 bbl. of oil in 24 hours.

Wayne County: H. Paul Tick 1 Withrow, C SE NE 32-1s-8e, dry at 3,181 ft. Glen Dean 2,468 ft., Aux Vases 2,979 ft., Ste. Genevieve 3,044 ft., Levias 3,055 ft., McClosky 3,114 ft., St. Louis 3,178 ft.

Pure Oil 1 C. A. Simmons, C E½ SW SE 9-1n-7e, dry at 3,295 ft. Upper Kinkaid 2,046 ft., Cypress 2,763 ft., Aux Vases 3,022 ft., McClosky 3,221-31 ft.

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SOUTHWEST TEXAS

Attention Turns to Wilcox Wildcat Play

CORPUS CHRISTI, Tex. — One of the most interesting developments in the Southwest Texas district at the present time is the concentrated Wilcox trend wildcat play in Bee, Goliad and De Witt counties where some 15 tests are drilling or scheduled to start soon.

Holding attention along this trend at the present time are three tests in Goliad and De Witt counties. In Goliad County, 10 miles northwest of the town of Goliad in the R. Walker Survey, Continental Oil Co. 1 Heard is bottomed at 9,003 ft. and 6-in. casing was cemented at 8,993 ft. About 4½ miles south of the Slick-Wilcox field, Continental 1 S. H. Reed is coring ahead below 8,201 ft., with shale and sand having an oil odor, logged at 8,071-81 ft., and shale and sand with a distillate odor from 8,151-54 ft.

The productive limits of the Slick field, Goliad County, were extended several hundred feet east with the completion of Continental Oil Co. 2 G. W. Allen, which is flowing from the Wilcox sand opposite perforated casing at 7,564-7,473 ft., and 7,577-79 ft., at the daily rate of 222 bbl. through a 5/32-in. choke.

Along the up-dip sector of this trend, and located in McMullen County, two wildcats were attracting attention. Edwin M. Jones 2-C Harry Ezzell, 8 miles southwest of Simmons City, cored shale and sand with a gas odor at intervals from 4,804-28 ft., and from 4,897-4,992 ft.

Development in the new Scott & Hopper field, Brooks County, is expected to be expanded by an excellent producer completed by Humble Oil & Refining Co. 3 Scott & Hopper, about 1,300 ft. due west of the discovery well. Total depth is 6,857 ft., with production thought to be from sand at 6,093-6,103 ft.

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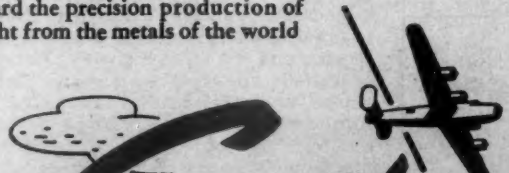

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southeast of Gregory, Humble 1 J. F. Green, the discovery well of the Gregory field, flowed at the daily rate of 287 bbl. of 55.6-gravity distillate on a 6-hour test flowing through a ¼-in. choke from perforated casing opposite sand at 9,120-40 ft. The rig is being moved in for 2 Green, about 2,600 ft. east of the discovery in the T. T. Williamson Survey.

The Texas Co. 2 H. C. de Tijerina, about 10½ miles southeast of the prolific Seelingson field, Jim Wells County, was officially gaged at 257 bbl. daily through a ⅛-in. choke with tubing pressure 1,875 lb. The oil tested 29.2 gravity and is from sand at 7,117-25 ft.

Sun Oil Co. appears to have opened a new strike or marked up a major extension to the Garcia field, southeastern Starr County, with the showing of 1 J. V. Solis, 2 miles northeast of the Garcia field.

SOUTH TEXAS WILDCAT COMPLETIONS

Bee County: Stanolind 1 K. D. Roche, 1 mi. southwest of Heard field, dry at 5,080 ft.

Brooks County: Sun-Humble 1 Lasater, HE&WT Sur., 349, dry at 6,767 ft.

Caldwell County: C. E. Starr 1 Hudgens, dry at 3,230 ft.

Hidalgo County: Sun 1 Fitzpatrick & West, 9 mi. west of Mission, dry at 6,508 ft. Sun 1 J. L. Garza, 3 mi. NE of San Manuel, dry at 9,018 ft. Texas 1 Rich, 6 mi. SE of LaReforma, dry at 7,542 ft.

Jim Hogg County: Arkansas 1 J. L. Spoonts, 4 mi. SE of Well field, dry at 5,014 ft.

Medina County: F. A. Brown 1 Wynne, 5 mi. NE of Ina field, dry at 1,162 ft.

Milam County: J. C. McKeehan 1 Patillo, 3 mi. N of Minerva, dry at 122 ft.

Starr County: J. B. Stoddard 1 P. Guerra De Saenz, 15 mi. N of Rio Grande City, dry at 4,011 ft. Sun 2 Samand, 2 mi. SE of Yturria, dry at 4,921 ft.

Williamson County: Fritz Fuchs 1 fee, W. Cartwright Sur., dry at 1,100 ft.

LEGAL

Notice of Oil & Gas Lease sale: The U.S. Department of Agriculture will award leases on 15 tracts of approximately 2,480 acres each in Cochran County, Texas, on former Slaughter Ranch. Rent $1.00 per acre. Awards limited to 1 tract per lessee. Sealed bids to be publicly opened April 17. Bid forms and additional information can be secured from Ray E. Davis, Acting Regional Director, Farm Security Administration, Old Post Office Building, Amarillo, Texas.

A. I. LEVORSEN

Petroleum Geologist

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MISSISSIPPI

Twenty Locations in Deep South Area

JACKSON, Miss.—A survey of wildcat activity in Mississippi, Alabama and Florida shows a total of 20 locations, drilling or slated to be drilled. In addition geophysical exploration is reported to be picking up and leasing throughout the general area is said to be quite active.

Probably the most watched area at the present time is the Gilbertown area, Choctaw County, Alabama, and the Suniland field in Florida, both of which opened the state's first oil production several weeks ago. While production from the discovery wells of the two pools has been small, they open a vast area of potential possibilities and some of the independents and major companies which moved out of the general area following the Tinsley play are now reestablishing offices and an expansion of development is anticipated.

In the Heidelberg field, a recent discovery in Jasper County, Mississippi, Gulf 1 Lewis is showing for a producer as a 10-minute drill-stem tsst at 4,555-4,581 ft., tested 28 lb. working pressure and recovered 13 bbl. of 27-gravity oil through a ⅜-in. choke on bottom and a ¾-in. choke on top.

KENTUCKY

Two Gas Wells Completed; Jackson County Active

ASHLAND, Ky. — Two gas wells were completed in eastern Kentucky this week, and at the same time information from reliable sources turns attention to Jackson County, where drilling has been successful in recent weeks.

Elmer Dare and associates, over the past year, have drilled several wells in Jackson County in the area bounded by Big Sturgis Creek, Black Log Branch and the state highway. These operations are close to the line and extend over seven leases.

Initial operations, according to these sources, had some gas wells with a dry hole or so, with producing oil wells reported on the Charley Mintor and Merida Johnson farms. Two oil wells were completed on the Wilson tract with a third now being drilled. A well is also being pumped on the Hughes tract.

Ashland Oil & Refining Co., and Basin Drilling Co. hit an outstanding producer in Union County in an area at the southeast corner of the city limits of Uniontown. Early estimates of production range to over 300 bbl. of oil per day. The well is near the cemetery and about ¾ mile from other oil producers in the area.

Reports received here indicate a considerable new producing area may be opened up by the discovery, which is in lower Cypress sand, 2,275-85 ft., total depth.

WESTERN KENTUCKY

OWENSBORO, Ky.—Ashland Oil & Refining Co. and Basin Drilling Co., 1¼ miles south of Uniontown, Union County, gave promise of extending the Uniontown pool in their 1 Nolin-Avery community.

Lower Cypress sand at 2,275-87 ft. was given a 30-minute drill-stem test and showed good gas, 1,050 ft. of oil, 60 ft. of drilling mud and no water. The best new well of the week was Cherry & Kidd 3 C. Melton, in Webster County, which started at 262 bbl. per day from Tar Springs sand at 1,855-62 ft., which had not been shot. Five oil wells and 5 dry holes were completed in Western Kentucky during the week.

WESTERN KENTUCKY WILDCAT COMPLETIONS

Henderson County: Kingwood 1 Posey estate, 5 mi. N of Henderson, dry at 2,518 ft. (through McClosky lime). Lower Glen Dean 1,794 ft., Barlow 2,062 ft., Renault 2,288 ft., Fredonia 2,404 ft.

Ohio County: Producers P.L. Co. 1 C. C. Price, dry at 1,311 ft. Barlow 986 ft., McClosky 1,232-37 ft., with small showing of oil.

CRUDE-OIL PRICES

Representative selected crude prices from all sections of the country appear below:

East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana	1.18
Illinois basin	1.37
Pecos County, Texas	.95
Bradford, Pennsylvania	3.00
Van, Van Zandt County, Texas*	1.00

*No change since 5-21-41.

Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill Calif.	Oklahoma, Kansas	Gulf Coast Texas	West Texas*
18-18.9	$0.80	....	....	....
19-19.9	.84	....	$1.06	$0.70
20-20.9	.88	$0.85	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	....	1.07	1.30	.94
32-32.9	....	1.09	1.32	.96
33-33.9	....	1.11	1.34	.98
34-34.9	....	1.13	1.36	1.00
35-35.9	....	1.15	1.38	1.02
36-36.9	....	1.17	1.40	1.04
37-37.9	....	1.19	1.42	1.06
38-38.9	....	1.21	1.44	1.08
39-39.9	....	1.23	1.46	1.10
40 and above	....	1.25	1.48	1.12

*Includes Lea County, New Mexico.

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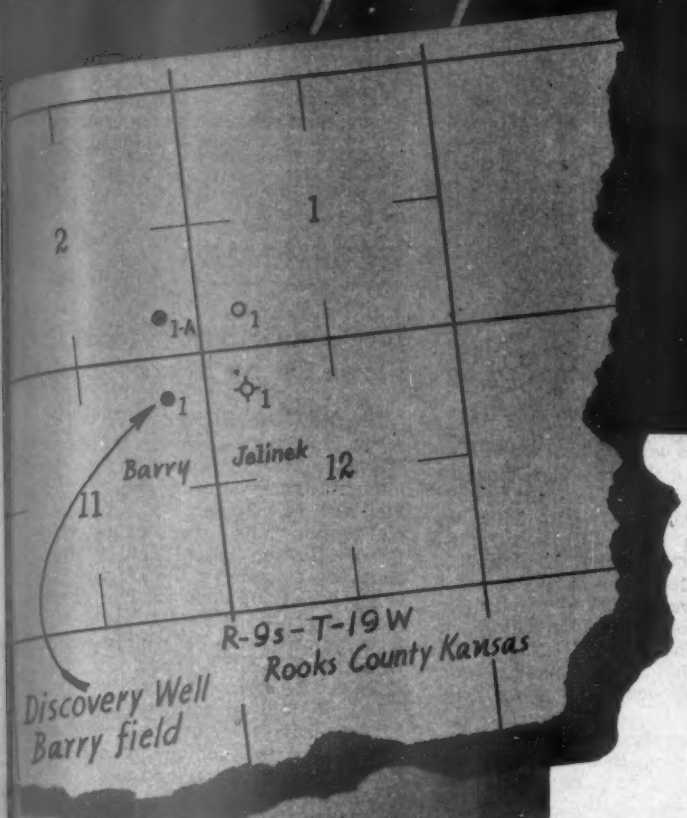

The above map shows a recently completed "Strat" hole in Rooks County, Kansas, out on the fringe of petroleum exploration. The well discovered the Barry field, producing from Arbuckle lime at 3400-3500 feet. The first two wells indicated the productivity of the area by gaining maximum state potentials of 3,000 barrels each. The field is defined on only one side; the east, where a dry hole has been completed. To the north, west and south the area is still wide open to development.

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LA.-ARK.

Tuscaloosa Well Finished After Long Testing Period

SHREVEPORT. — Two discovery wells were completed last week, one each in Louisiana and Arkansas. In central eastern Louisiana, The California Co. finished its Tuscaloosa discovery after many months of testing, flowing 325 bbl. in 24 hours. Description of the well, located just west of the town of L'Argent in Tensas Parish, is 675 ft. east and 665 ft. south of the SW SW NW of irregular section 46-9n-10e.

In Columbia County, Arkansas, Tide Water-Seaboard Oil Co. completed its 1 Pearce for 32 bbl. of oil in Smackover lime at 8,282-87 ft. and 8,290-98 ft. Location is northeast of Macedonia and south of the Magnolia pool.

Lafayette County.—Southwood Oil Co. brought in the forty-first producer for the Midway field last week when its 6 Hodnett, SW SW 7-15s-23w, flowed oil from the Smackover lime at 6,432-57 ft. Flow gage was not to be taken until the well had cleaned itself. Location is on the north side of the eastern end of the pool.

NORTH LOUISIANA WILDCAT COMPLETIONS

Bossier Parish: J. R. Hayden 1 Elerbe, SE NE NE 3-20n-13w, dry, TD 6,026 ft.
De Soto Parish: M. W. Brush 1 Peek, SE NW NE 25-11n-13w, dry, TD 2,210 ft.
Tensas Parish: California Co. 1 J. W. Brown, 46-9n-10e, flowed 325 bbl., Tuscaloosa 9,067-80 ft., TD 9,130 ft.
Placid Oil Co. 1 Ayers, NE NE 18-14n-11e, dry, TD 9,770 ft.

ARKANSAS WILDCAT COMPLETION

Columbia County: Tide Water-Seaboard 1 Pearce, NE NW 10-18s-20w, flowed 32 bbl., Smackover 8,282-87 ft., 8,290-98 ft., TD.

OHIO

Sandyville Field Yields Large Gas Wells

ZANESVILLE, Ohio. — The area southeast of Richville is accounting for the best gas wells now being drilled in the Sandyville field. This area, covering 9 sq. miles, has yielded 12 gas wells and 1 dry hole with 6 wells drilling. Last week J. C. Steiner completed in the pool the 1 fee in Section 36, Perry Township, Stark County, with a shut-in volume of 2,494,000 cu. ft. after shot, and at a rock pressure of 1,310 lb. Sand was drilled from 4,548-4,641 ft. with the pay in the bottom part.

The lime sand pool in Section 1, Franklin Township, Monroe County, was extended a location to the west by a 50-bbl. well on the Stoffle tract completed by Leonard Hines.

The Clayton pool had a 105-bbl. completion on an inside location by the Preston Oil on the Yarger consolidation in Section 5.

South Penn has cemented the casing 50 ft. in the Niagara lime in their wildcat test in Monroe County and will drill in next week.

KANSAS

Chitwood Pool Extended by Viola and Simpson Wells

BOTH field and wildcat operations throughout the state were more encouraging last week. In Pratt County, two extension wells expanded the proven area of the Chitwood pool. Deep Rock Oil Corp. 1 Coulson, SW SW SW 23-28-12w, a south and west outpost, flowed 2,463 bbl. of oil a day in Viola lime while Lion Oil Refining Co. 1 Mawdsley, NE NW SE 22-28-12w, carried Simpson sand production ½ mile west with a 1,558-bbl. well.

Russell County.—Three miles east of Hall-Gurney, Bridgeport Oil Co. was completing its 1 Beisel, SW SW NW 15-14-12w, in the Arbuckle at 3,265 ft. No estimate as to the potential was made but oil rose 1,300 ft. in 13 hours. Total depth was 3,284 ft.

Barton County.—Western Exloration Co.'s wildcat, 1 Titus, was given up as a dry hole after several acid treatments failed to increase production. The Arbuckle at 3,526 ft. had a good show and a small treatment produced 150 ft. of oil, then put 800 ft. of oil in the hole. Three more treatments with acid increased the swabbing rate from 2½ bbl. of oil an hour to 5 bbl. Total depth was 3,576 ft. Location is 1 mile south of Mid-Continent Petroleum Corp.'s 1 Harrison, which made a small pumping well in the Arbuckle at 3,520-29 ft.

KANSAS WILDCAT COMPLETIONS

Barton County: Mineral Products Co. 1 A. H. Reif, NW NW SW 30-16-12w, pumped 131 bbl. in 13 hr., Arbuckle 3,400-03 ft.
Helmerich & Payne 1 Frederick, SE SE SE 15-16-11w, dry, TD 3,470 ft., Arbuckle 3,438 ft.
Western Exploration Co. 1 Titus, NE NE NW 19-20-13w, dry, TD 3,562 ft.
Finney County: Shallow Water Ref. 1 First Natl. Bank of Hays City, NE SE 30-21-33w, dry, TD 4,750 ft., Lansing 3,897 ft., Mississippi lime 4,641 ft.
Hodgeman County: Continental Oil 1 L. C. Koontz, SW SW SW 30-23-21w, dry, TD 5,097 ft., Mississippi lime 4,617 ft., show oil in dolomite at 4,633 ft., Simpson 5,036 ft., Arbuckle 5,050 ft.
Morton County: Eason Oil Co. 1 Craver, SE SE SE 32-34-42w, dry, TD 4,731 ft., Mississippi lime 4,700 ft.
Saline County: Pryor & Lockhart 1 Duncan, SE SE SE 35-13-1w, dry, TD 3,307 ft., Arbuckle 3,275 ft.
Rooks County: Sunray 1 Federal Land Bank, SE SE SE 20-6-19w, dry, TD 3,618 ft., Lansing 3,347 ft.
Stafford County: Shell Oil Co. 1-A Ruegen, SE SE NW 4-21-11w, dry, TD 3,499 ft., Arbuckle 3,387 ft.
Appleman et al 1 Fisher, S½ SW NE 30-21-12w, dry, TD 3,698 ft., Arbuckle 3,655 ft.

MISSOURI WILDCAT COMPLETIONS

Jackson County: Boten Bros. et al 1 Liggett, SW SE NW 11-48n-31w, pumped 1 bbl. oil an hr., sand 223-253 ft., TD 480 ft., PB to 253 ft.

OKLAHOMA

McClain County Wildcat Flows Oil by Heads

REPORTS from The Carter Oil Co. 1 Cottingham, deep test in SE SW 4-7n-3w, McClain County, substantiate the general opinion that the well will be completed as a commercial producer. At the end of last week it was flowing oil-cut mud after 10 shots were made in the second Wilcox sand at 10,625-40 ft. The packer was set at 10,585 ft. However, later tests indicated that the well had nearly cleaned itself. Opened all night, it flowed by heads at the rate of 6 to 7 bbl. of fluid an hour, cutting 10 to 15 per cent sediments and mud, no water, and the remainder oil. The flow was through 2-in. tubing with a 1¼-in. choke on top.

Operators have been ordered to pull the tubing and perforate a 10-ft. section just below the previous shots. It is in this part of the sand zone that large production is expected. At the above rate of flow, the well now has an indicated potential of well in excess of 100 bbl. a day. However, the owners are confident that the lower sand section will greatly increase its production. Cores in this section were more favorable than those recovered in the zone from which the well was flowing. Total depth of the well is 11,209 ft.

It is generally agreed that this is one of the state's most important wildcat tests. Production here of around 500 bbl. a day would set off an active drilling campaign in the Anadarko basin, which has long been looked to as the future hope of the state. Over the past few months the area immediately west of the Nemaha Ridge has witnessed an intense geophysical program. However, this entire basin has had a record number of seismograph crews in operation over the past year. It has been said that shooting parties in some fields are so close together that their own records were overlapping.

Garvin County. — An important wildcat test is getting under way some 3 miles west of the Pauls Valley pool. Continental Oil Co. was moving in tools last week at the 1 Parks, SE NE SE 28-4n-1w. Dry-hole contributions are being furnished by Margay Oil Co., Ohio Oil Co., Devonian Oil

Wildcat Completions and Discoveries

	Week ended March 18, 1944					Cumulative total for 1944				
	Oil	Distillate	Gas	Dry	Total	Oil	Distillate	Gas	Dry	Total
Ohio	0	0	0	0	0	0	0	6	14	20
Indiana	0	0	0	0	0	0	0	0	3	3
Kentucky	0	0	0	2	2	1	0	0	13	14
Illinois	1	0	0	7	8	5	0	0	60	65
Michigan	0	0	0	2	2	3	0	0	45	48
Kansas	1	0	0	9	10	12	0	0	76	88
Nebraska-Missouri-Iowa	1	0	0	0	1	1	0	0	6	7
Oklahoma	1	0	1	6	8	9	0	6	43	58
Texas:										
North Central	0	0	0	6	6	7	0	0	52	59
West	0	0	0	3	3	6	0	0	28	34
Panhandle	0	0	0	0	0	0	0	0	2	2
East	0	0	0	0	0	0	0	0	27	27
Gulf Coast	0	0	0	3	3	14	3	3	48	68
Southwest	0	0	0	12	12	6	2	5	54	69
Total	0	0	0	24	24	35	5	8	211	259
Louisiana:										
North	1	0	0	3	4	2	0	0	11	13
Gulf Coast	0	0	0	0	0	2	4	0	15	21
Total	1	0	0	3	4	4	4	0	26	34
Arkansas	1	0	0	0	1	2	0	0	11	13
Mississippi and Southeast	0	0	0	1	1	3	0	0	19	22
Montana	0	0	0	0	0	1	0	0	2	3
Wyoming	0	0	0	1	1	3	0	0	5	8
Colorado, Utah	0	0	0	0	0	1	0	0	2	3
New Mexico	0	0	0	2	2	0	0	0	17	17
California	0	0	0	1	1	3	0	4	26	33
Total United States	6	0	1	58	65	83	9	24	581	695
Total previous week	6	1	1	32	40					

WILDCAT discovery wells were down for the second consecutive week, with 6 oil wells and 1 gas well out of a total of 65 tests finished. There were no new oil or gas wells reported for the entire State of Texas.

The week's largest discovery was in Hughes County, Oklahoma, where Deep Rock Oil Corp. got a 386-bbl. Cromwell sand well some 4 miles from nearest oil production. Deep Rock has done considerable geological work around these old producing areas and has uncovered a number of small pools. Future possibilities in such areas cannot be predicted, however, until a number of offsets have been drilled.

Co. and Cities Service Oil Co. No definite contract depth was announced, although it will penetrate all producing zones found at Pauls Valley.

OKLAHOMA WILDCAT COMPLETIONS

Hughes County: Deep Rock 1 Myers, SE SE NE 7-7n-10e, flowed 386 bbl., sand 3,587-90 ft.

Kay County: J. E. Crosbie 1 Kay-State, NE SW SW 16-29n-3e, dry, TD 3,766 ft., Simpson 3,605 ft.

Texas Co. 1 Warren Ranch, NE NE SE 30-29n-4e, dry, TD 3,658 ft., Arbuckle 3,608 ft.

Lincoln County: J. J. Fleet 1 Moore, SW NW SE 21-17n-2e, dry, TD 4,781 ft., Layton 3,325 ft., Wilcox 4,774 ft., recovered 150 ft. of oil and 800 ft. of water.

Love County: Magnolia Pet. and Merrick 1 Tate, E½ SE NE 6-6s-2e, dry, TD 4,013 ft., est. 60,000 cu. ft. of gas in Springer sand at 3,304 ft.

Okfuskee County: Texas Co. 1 Tanner, SW SE NE 28-12n-9e, 13,100,000 cu. ft. gas, Cromwell 3,272-95 ft., TD 4,056 ft., 1,300 lb. RP.

Pawnee County: Northern Ordnance 1 Brown, NW SE SW 20-23n-3e, dry, TD 4,233 ft., Layton 3,712 ft., Wilcox 4,197 ft.

Pittsburg County: Public Service 1 Nelson, NW SE SE 35-7n-14e, dry, TD 3,581 ft., sand 3,440 ft.

R. B. Warren Purchases Properties in Panhandle

R. B. Warren, Jr., president of the Coronado Oil Co., Tulsa, has announced purchase of Dawson & Tharp Oil Co.'s interest in five leases in Gray County, Texas, for approximately $300,000 cash. There are 20 producing wells on 520 acres with about 15 or 20 prospective locations to be drilled. The purchase became effective March 1.

Increases in Ceiling Prices Granted Three Oil Fields

WASHINGTON. — Three oil fields, two in Louisiana and one in Arkansas, were granted increases in their ceiling prices by Office of Price Administration last week. The increases are provided in Amendment 10 to Maximum Price Regulation 436 — crude petroleum and petroleum and natural gas.

The three increases were:

1. At Urbana field, Union County, Arkansas, the ceiling at the receiving tank for heavy crude oil is increased from 74.7 cents to 88 cents a barrel. Daily production at this field is approximately 400 bbl. This increase is retroactive to January 12.

2. At South Elton field, Jefferson Davis Parish, Louisiana, the ceiling at the receiving tank for crude petroleum and crude distillate is increased from $1.18 to $1.30 a barrel for 40-gravity oil and higher. The customary 2-cent differential applies to lower gravity oils produced. This increase is effective March 22.

3. At Tullos-Urania field, La Salle Parish, Louisiana, the ceiling at the receiving tank for crude oil is increased from $1.15 to $1.25 a barrel. Daily production at this field is approximately 2,000 bbl. of crude oil. This increase is effective March 22.

At the same time, a clarification was provided in connection with the ceilings for California crude oil. In April 1943, when maximum prices were established for various fields in California, two different bases were set up, depending primarily upon whether or not buyers had posted a field price. There was an ambiguity in the schedule with respect to the method to be followed at certain fields. The clarification made will cause no change in maximum prices.

Application Filed for Texas-California Line

WASHINGTON. — Application was filed here last week for priorities assistance in obtaining steel and other material for a 20-in. crude-oil line from Monahans, Tex., to Beaumont, Calif., a distance of 930 miles. The application was by Pacific War Emergency Pipelines, Inc.

There was no indication given immediately by the Petroleum Administration for War whether it would approve or reject the application. Earlier discussions of a West Texas-California line have not received particularly serious consideration.

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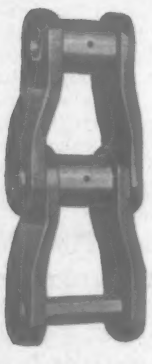

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Among the Drilling Contractors

Fain Drilling Co., Houston, has a total of nine rotaries running in the Texas area, eight of which are situated in the Gulf Coast area and the other in the East Texas district. Two heavy rotaries located on the South Texas Development Co. and Winslow leases, Lake Creek field, Montgomery County, for Stanolind Oil & Gas Co. and Progress Petroleum Co. are below 10,000 ft. In the Goliad-De Witt County area, near the new Slick field, three rigs are running for Continental Oil Co. and one for Stanolind Oil & Gas Co. Drilling was started in the Willamar field, Willacy County, while in San Jacinto County, preparations are being made to drill a wildcat for Stanolind Oil & Gas Co. In the East Texas district, drilling was started on Unit H, a wildcat located near the town of Athens.

George Miller has the drilling contract on the Clark C. Nye 1 Bartlow, in NW SW 16-16n-8w, Park County, Indiana, which has been staked for a 1,600-ft. test.

Falcon-Seaboard Oil Co., Houston, is moving one of its rotaries from the Gibson field, Terrebonne Parish, Louisiana, to the La Pice field, St. James Parish, Louisiana, for Shell Oil Co., Inc., while in the West Tepetate area, Jefferson Davis Parish, Louisiana, drilling was scheduled to get under way for Barnsdall Oil Co. On the Texas side of the Gulf Coast, two operations are reported, one being located in the Fig Ridge field, Chambers County, for Sun Oil Co. and the other in Newton County, a wildcat operation for Gulf Oil Corp. In the West Texas district, near the town of Odessa, one rig is operating for Shell Oil Co., Inc.

Ralph Perry has the drilling contract on the Harris Oil Co. 1 Barbieri, in NE NE SW 24-2s-16w, Van Buren County, Michigan.

Housh & Thompson, Houston, have moved two rotaries to Colorado County, Texas, near the new Wilcox sand discovery, recently opened by Ohio Oil Co. Both locations are on the Ammann leases and will be drilled for Northern Ordnance, Inc. Drilling continues in the Katy field for Humble Oil & Refining Co., while in the new Cottonwood field, Liberty County, Texas, drilling was started on a second well for William Helis.

Cron & Gracey, Houston, have three rotaries running in coastal Louisiana, one being located in the Gibson field, Terrebonne Parish, one in the Lake Long field, La Fourche Parish, for Fohs Oil Co., and a workover job in the South Houma field for Shell Oil Co., Inc.

Stuart Merrill has been awarded drilling contract on the J. V. Wicklund Development Co. A-1 State-Deep River, in C S½ SW SE 6-19n-4e, Arenac County, Michigan.

E. J. Gracey, Houston, is starting a new operation in the McFaddin field, Jefferson County, Texas., for Shell Oil Co., Inc.

Harry L. Edwards Drilling Co., Houston, has moved a rotary to Brazoria County, Texas, where contract for a wildcat was received from Kirby Petroleum Co. In addition, three other rotaries are active in the Old Ocean field, Brazoria County, for Abercrombie-Magnolia, in the Hitchcock field for McCarthy and Phillips Petroleum Co., and in the Fig Ridge field, Chambers County, Texas, for the Frost interest.

J. W. Lang is the drilling contractor on the Michigan Devonian Petroleum Co. and J. W. Lang 1 Henry Boeve, in SE SE NW 12-4n-15w, Allegan County, Michigan.

Dixie Drilling Co., Houston, continues to test Sinclair Prairie Oil Co. 1 A. J. Thompson in the New Ulum area, Colorado County, Texas, which looms as the discovery well of a new Wilcox sand pool. Four rigs are running in the Paradis field, St. Charles Parish, Louisiana, for the Texas Co., while another rotary is located near the town of Franklin, St. Mary Parish, Louisiana, for Atlantic Refining Co.

Morris Hamilton Drilling Co., Houston, has moved a rotary to the new Bear field, Beauregard Parish, Louisiana, for Phillips Petroleum Co. In the Vinton field, Calcasieu Parish, Louisiana, preparations were being

made to start another test for Union Oil Co., while in the same field, two directional holes are being drilled for Gulf Oil Corp.

Wynn Crosby Drilling Co., Houston, is moving a rotary 6 miles northeast of Smiths Point, Chambers County, Texas, for 1 Mayes White, a wildcat located in the G. Long Survey. Another rotary is being moved to Harris County, Texas, for 1 Bassett Blakely, a wildcat 3½ miles southwest of Barker.

Glenn H. McCarthy, Houston, is moving a rotary to Jefferson County, Texas, for his 2 McFaddin Trust, a projected deep wildcat located 4 miles southwest of Hamshire.

Todd Drilling Co. received contract from Phillips Petroleum Co. for 1 Foster, a wildcat located in the J. M. De La Garza Survey, Montgomery County, Texas.

Hollandsworth Drilling Co., Longview, Tex., has moved in to drill a 5,000-ft. wildcat test in northern Lamar County for Cosden Petroleum Co. The test is on W. T. Adams' farm in the J. R. Gibson Survey, about 2 miles north of Faught.

—**W. Spencer Cook** has been awarded contract by Charles W. Cook and Del Fortney to drill their 1 Edmund R. Beaver, in SE SW NW 4-3n-12w, Allegan County, Michigan.

Fisher-McCall Oil & Gas Co., Inc., is the drilling contractor on the Southwest Development Co. 1 Jacob W. Gorton, in NW SE NW 13-2n-12w, Allegan County, Michigan.

James Collins will drill the Robert Bond 1 Sam Musser and others, in SW SE SW 33-14n-11w, Newaygo County, Michigan.

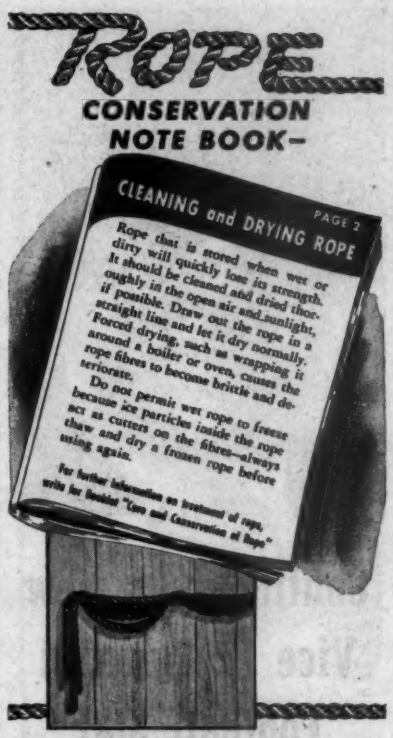
Homer O'Neil has been awarded drilling contract on Elmer A. Roth 1 Edward Roney, in SW SE NW 27-7n-17e, St. Clair County, Michigan.

S. W. S. Drilling Co., of Edmonton, Alta., has the contract for a test of 3,000 ft. or more to be drilled for British-American Oil Co., Ltd., in the south plains area of Alberta about 20 miles east of the Red Coulee field.

Two States Drilling Co. received contract for a 9,000-ft. test from Ohio Oil Co. for 3 McDonald, located in the North Bay City extension area, Matagorda County, Texas.

THE JOHNSTONS ARE A DRILLING CONTRACTOR FAMILY

The six sons of R. C. Johnston, Sr., were photographed in Houston recently where they attended the funeral of their father, whose death at 84 ended an oil-field career begun following Spindletop's discovery in 1901. The father drove his family, including five sons, from Parker County to Beaumont in a wagon when news of the Lucas well spread. J. T. Johnston, the second son, died in Beaumont more than 10 years ago. He organized Arkansas Drilling Co., El Dorado, Ark., which he headed until his death. E. L. and R. C., Jr., were born in the oil fields. All seven sons began as roughnecks, were made drillers, and then became drilling contractors. Their record as a family challenges all records for putting manpower in the oil industry . . . for footage drilled personally, or under their direction. Left to right: Blaine, technical advisor for Johnston Oilfield Service Corp., Houston, following his retirement recently as general superintendent for Crown-Central Petroleum Corp.; E. L., superintendent in charge of drilling and production for Delta Drilling Co. in Illinois, Indiana and Kentucky, with headquarters at Evansville, Ind.; M. O., president of M. O. Johnston Oilfield Service Corp., Los Angeles; R. C., vice president in charge of drilling and production for Delta Drilling Co., Tyler Tex.; J. L., superintendent in charge of drilling and production for E. C. Johnston, and E. C. Johnston, owner of the producing and contracting interests that bear his name, Longview, Tex.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PERSONALS

Continental's New Vice President a Football Star

JAMES J. COSGROVE, who last week was elected a vice president of Continental Oil Co., has been general counsel for that organization since 1929, with headquarters in Ponca City, Okla. As an All-American football player Cosgrove became a national figure while attending Cornell University. After receiving his A.B. at Cornell he entered the law school of University of Pittsburgh and was admitted to the bar in 1912. He established a law office in Pittsburgh and practiced there until 1917, when he enlisted for service in the first World War. He was commissioned a captain and later was promoted to major.

After the armistice Major Cosgrove was transferred to Washington, where he became a member of the War Department board of appraisers and later a member of the department's claims board. Soon afterward he was appointed special attorney for the commissioner of internal revenue.

In 1922 he joined the legal staff of The Texas Co., continuing in that position until he entered Continental service. Along with his vice presidency Cosgrove will retain his post as general counsel.

Joseph E. Dean, formerly right-of-way and claim agent, has been made personnel director of The Ohio Oil Co.'s pipe-line department, with headquarters in Martinsville, Ill. Coordination of certain activities in the personnel department has been placed in the hands of **W. J. Wilson,** with the title of assistant personnel director. **F. G. Bruchlacher** has returned to the personnel department as an assistant director, to take up the work previously performed by Wilson.

Rex Woods, reservoir engineer for Gulf Oil Corp., Tulsa, has joined Petroleos Mexicanos in Mexico City. Woods graduated from Pennsylvania State College in 1931 and during the past few years has devoted his attention to reservoir and valuation problems.

John M. Scrogin, for the past year a member of Phillips Petroleum Co.'s geological staff in Houston, has been made head of the Permian basin division office, in Fort Worth, of American Trading & Production Corp., a recently organized development concern with headquarters in Baltimore.

L. A. Farmer, president of Northern Oklahoma Gas Co., Ponca City, was elected chairman of the gas division of Oklahoma Utilities Association, meeting in Oklahoma City last week. **S. I. McElhoes,** director of Public Service Co. of Oklahoma, Tulsa, was chosen chairman of the electric division.

D. L. Connelly has resigned as manager of the Gulf Coast division of Cities Service Oil Co. to become production manager of Warren Petroleum Corp. His office will be in Houston, with branch offices at several points where Warren has natural-gasoline plants.

James B. Thompson, for 15 years purchasing agent for Shell Pipe Line Corp., Houston, has been appointed director of materials for District 3, Petroleum Administration for War. He takes the place of **C. Edward Naylor,** head of Maintenance Engineering Corp., Houston, who joined PAW in 1942 and who resigned the District 3 post.

Ford Fullingim, of Houston, has been appointed deputy supervisor of the Midland office of Texas Railroad Commission. Fullingim served the commission as a deputy supervisor from 1932 to 1939 in Beeville and Houston.

Walter L. McKinnon, office manager of the Houston refinery of Shell Oil Co., Inc., has been granted a leave of absence to serve as labor adviser in the process section, refining division, Petroleum Administration for War, in Washington. McKinnon started with Shell as a clerk in 1929. **Dene B. Hodges,** manager of transportation and supplies, has similarly been granted leave in order to serve as associate director of the supply and transportation division of PAW.

Dr. H. J. Sawin, assistant geologist in the Bureau of Economic Geology at University of Texas, has undertaken a study of a prehistoric reptile found in Howard County, Texas, in an effort to provide oil and water-well drillers with fuller information concerning the Triassic formation.

J. R. McWILLIAMS

J. R. McWilliams, manager of The Carter Oil Co.'s production department, was named a vice president last week and was appointed manager of the Northwest division with headquarters in Billings, Mont. He succeeds **Ralph E. Damp,** transferred to the main offices in Tulsa as general production superintendent. **R. L. Clifton,** general production superintendent for 8 years, has been named acting manager of the production department to succeed McWilliams. McWilliams joined Carter in 1934; Damp, in 1926, following his graduation from University of Minnesota; Clifton, in 1917.

RALPH E. DAMP

R. L. CLIFTON

Thomas A. Dines has resigned as president of Saltmount Oil Co. and of Mountain Producers Corp., affiliates, of Denver, owing to press of other duties. **Harold Herndon** succeeds him as head of Saltmount and **Gene E. Griffith** as head of Mountain Producers. Dines is president of Utah Oil Refining Co., United States Na-

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tional Bank of Denver, and other large corporations.

Marshall Newcomb, Dallas, has been named general attorney for Lone Star Gas Co. He joined the legal staff of Lone Star in 1928 and has been assistant general attorney since 1935. "At 39," said **D. A. Hulcy,** president, "Newcomb becomes one of the youngest general attorneys of any large corporation in Texas."

Oscar Wolfe, who served as chief engineer for War Emergency Pipelines, Inc., in construction of the 24 and 20-in. lines, has returned to The Texas Co. and has been assigned to the department of foreign operations, of which **C. E. Olmsted,** vice president, is head. His headquarters will be in New York.

George E. Burgher has been named land representative for Continental Oil Co. in Tulsa, succeeding the late A. L. West. Burgher entered the oil business in 1918 when he organized Burgher Oil & Gas Co., Tulsa. In 1927 he became president of Bur-Kan Petroleum Co., which operated in Oklahoma, Indiana and Illinois.

Russ Green, vice president of Signal Oil & Gas Co. in charge of production, chairman of the operating committee of Long Beach Oil Development Co., and secretary and chairman of the operating committee of Southwest Exploration Co., was recently elected vice chairman of the wildcat committee of California Oil and Gas Association.

C. C. Steinberger, Jr., Houston, for the past several years an independent operator in the Houston-Beaumont area, has been placed in charge of the Midstates Oil Corp. land department at Houston, a position formerly held by **J. M. Mouser,** who was recently transferred to Wichita Falls, Tex.

Clark Snider, geologist, formerly with Lario Oil & Gas Co. at Mount Vernon, Ill., has been transferred to the Wichita, Kans., office of The Globe Oil & Refining Co., an affiliate.

C. E. Bradford, who was a geologist for Standard Oil Co. of Texas in Houston, has been made senior geologist of the company's West Texas division, with headquarters in Midland. Bradford was with Standard Oil Co. of California and its subsidiary, Standard Oil Co. of British Columbia, before joining the Texas Standard.

James L. Morris, geologist for Pure Oil Co., has been named vice president of Fort Worth Geological Society to fill out the unexpired term of **William Gill,** who recently went to Jackson, Miss., as geologist for Hunt Oil Co.

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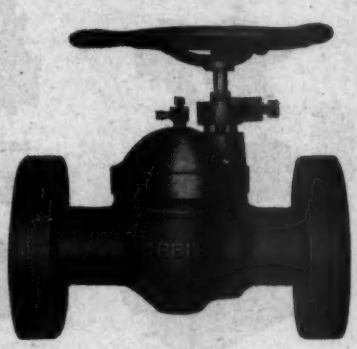

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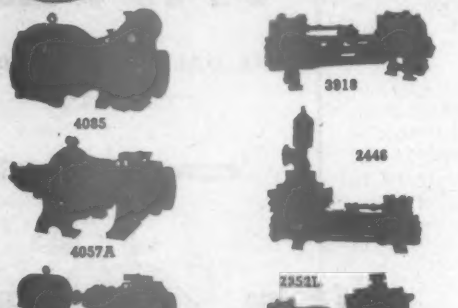

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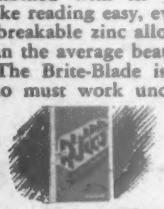

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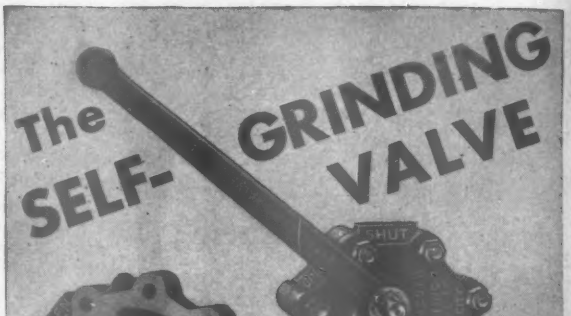

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Market Developments

INVESTIGATION of petroleum-distribution practices under wartime conditions has been scheduled by the Lea subcommittee of the House which has developed into one of the industry's chief sounding boards without discrimination between factions. Many of the evils which have resulted from wartime operation and at least partially the outgrowth of limited supplies and transportation facilities will be paraded before the committee.

One of the most bitter attacks of the emergency period has been leveled at committees directing distribution on the East Coast under authority of Directive 59 and PAO 1 and 5. Charges are made that major companies are dictating distribution policies and that through interpretation of administrative orders the independent jobbers and dealers are prevented from importing products into District 1 without first obtaining special permission. Applications for permits covering imports which fail to qualify under Directive 59 are generally rejected, according to the Eastern Petroleum Importers Conference which managed to place its protest on record through Rep. Jerry Voorhis of California.

Directive 59 is the instrument through which primary suppliers on the East Coast virtually pool receipts and distribute the total on a basis intended to maintain equity among the various companies and individuals. Malpractices under the cloak of Directive 59 and PAOs 1 and 5 are alleged by the Eastern Petroleum Importers Conference. The Lea committee and other congressional investigative committees may probe validity of claims by independent jobbers.

Consensus in the industry is that district committees and the PAW division in charge of distribution have handled a difficult situation with relative high efficiency and, generally speaking, in such fashion that prewar relations have been substantially sustained. Meanwhile, refiners reported little apparent change in their business outlook as a result of the cut this week in basic gasoline rations. "We haven't been able to fill civilian demand for motor fuel, anyway," declared one refiner in the Mid-Continent.

Similarly, the heavy rains reported in agricultural regions have not lessened the inflow of orders for gasoline for farm use. Buyers in rural territory are stocking up as well as they can for the spring plowing which soon will be under way. Pressure of war requirements continued to keep refinery stocks of gasoline low.

Consumption of light fuel oil was decreasing slightly in some areas, but not enough to have any appreciable effect on shipments from Mid-Continent refineries, which have not been able for months to keep up with appeals for this product.

Natural-gasoline manufacturers said they were able to meet major demands, but that a few scattered points needs were not being filled completely.

The daily gasoline quota for District 5 during the second quarter of 1944 was increased 10,000 bbl. to 140,000 bbl., but OPA reduced A and B gasoline rations to the same level in effect on the Atlantic seaboard. This reduction in coupon values on the Pacific Coast has been expected since the first of the current year.

A.P.I. Refinery Report

Week Ended March 11, 1944

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gasoline	Stocks: Residual	Stocks: Gas oil
Appalachian	147	3,360	366	1,443
Ind., Ill., Ky.	754	19,753	2,872	5,749
Okla., Kans., Mo.	344	8,391	1,262	1,528
Censored area*	2,226	37,556	15,523	14,741
Rockies	99	2,158	541	364
California	817	15,341	30,793	8,880
Total 3-11-44	4,387	86,559	51,362	32,705
Total 3- 4-44	4,344	86,091	51,175	33,145
Total 3-13-43	3,546	94,280	68,455	34,427

*Reports combined on East Coast, Texas Gulf Coast, Louisiana-Arkansas and Inland Texas as request of PAW.

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
March 11, 1944	236,748,000
March 4, 1944	237,763,000
March 13, 1943	236,655,000

*Excludes unrefinable stocks in California.

REFINERY PRICE SUMMARY

(Prices as of March 21, 1944)

Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.

REFINERY GASOLINE

Octane (A.S.T.M.):	80†	72-74	68-70	63-66
Mid-Continent*	‡6.00-6.25	5.750-6.000	.....	5.625
Gulf Coast	6.00-6.50	§5.750-6.250	§5.750-6.250	§5.250-5.750
Northeast Coast	9.80	9.2	9.2	.....
California	.....	6.255-6.500	5.750-6.125	5.125-5.500

*Basis Group 3. †1939 C.F.R. (research method). ‡Inland Texas and adjoining counties in Arkansas and North Louisiana. §Unleaded.

KEROSENE AND DISTILLATE FUEL OIL

Product:	Kerosene†	No. 2	No. 3	No. 5	No. 6‡
Mid-Continent*	4.125-4.375	3.500-3.625	3.375-3.500	$0.85	$0.80-1.27
North Louisiana*	4.125-4.375	3.500-3.625	.....	.....	0.80-1.27
Pennsylvania	6.000-6.125	5.875-6.125	5.875-6.000	.....	.....
California	4.500-5.500	5.500	5.500	§1.10-1.25	¶1.10-1.15
Northeast Coast	6.800	6.700	6.700	1.95	1.65
Gulf Coast	4.125	3.750-3.875	.....	1.35	0.85

*Reflecting OPA ceilings, depending on destination of shipments. †Quotations for 41-43 gravity. ‡Range depends on gravity. §Pacific Specification 300. ¶Pacific Specification 400.

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	4.750	5.700
North Texas	4.375	5.250
North Louisiana	4.375	5.250
California	4.875	5.500

LUBRICANTS

PENNSYLVANIA GRADE—	
Bright stock,* 10 pour point	30.5
Bright stock,* 25 pour point	25.0
Steam refined, 600	15.0
Neutral oil,† 10 pour point	34.0
Neutral oil,† 25 pour point	28-32.5
*No. 8 color, 145-155 at 210, 540-550 flash. †150 vis. at 70° F., 3 color, 400-405 flash.	
MID-CONTINENT—	
Bright stock, 150-160 D, 0-10	23.00
Neutral oil,‡ 200-3	15.00
‡0 to 10 pour point.	
GULF COAST—	
Pale oil, 200-3	8.75
Pale oil, 500-3½	10.00

WAX

Oklahoma, 124-126, w.c.s.	4.250
Pennsylvania, 122-124, w.c.s.	4.250
NEW YORK (in bags)—	
Refined, 130-132 (A.m.p.)	7.00
Crude, 124-126 (W.s.)	6.00

TANK-WAGON PRICES

(Gasoline prices based on regular grades in cents per gallon.)

	Dealer tank wag.	Combined tax	Kero. tank wag.
Baltimore, Md.	15.95	5.5	10.5
New York	16.10	5.5	10.1
Philadelphia	16.20	5.5	11.9
Washington, D. C.	15.20	4.5	11.3
Chicago	14.10	4.5	10.6
Cleveland, Ohio	14.50	5.5	*9.0
Atlanta, Ga.	18.90	7.5	*11.5
Denver, Colo.	14.50	5.5	11.0
San Francisco	14.50	4.5	11.5
Tulsa	16.50	7.0	8.5

*Includes 1-cent state tax.

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Have preliminary information on several wildcat blocks of leases in Texas and Louisiana. Some with favorable geology available. Blocks would have to be leased and geology checked or rechecked. Have had long experience and desire financial backing to carry on a wildcat program. Will expect salary, expenses and carried interest. Box C-190, The Oil and Gas Journal, Tulsa, Okla.

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KARNES COUNTY, TEXAS — For Sale 2,500 acres checkerboard leases across county. Six new fields discovered in this county in 1944. Ed Houlihan, Box 444, Beeville Texas.

ARKANSAS-Louisiana-Texas leases twenty acres up. Dollar acre up. Owners Box 1122, Little Rock, Arkansas.

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Humble Oil & Refining Co., now drilling a scheduled 7,500 foot test. Other major oil companies own lease blocks near test. I offer 40 acres and multiples thereof in same area. Write for information. HARRY S. WRIGHT, New Mexico State Lessee Farmington, New Mexico.

LUBBOCK County Lease for sale. W½ Sc. 43, Bl. P. offsetting location made in NW¼ Sc. 44, Bl. P. for new oil test NW Lubbock County. C. L. Craig, Perryton, Texas.

FOR SALE: Oil and gas leases and small production, located in Southwestern Kentucky, near drilling and producing wells. W. P. Harley, Bowling Green, Ky.

WEST TEXAS — New, long term leases, lowest price, cheapest rentals, large or small tracts. Do you have block anywhere you want drilled, OR do you want block to drill. Information and maps write: F. L. Welch, 1711 Roosevelt Ave., San Antonio, Tex.

FOR SALE: Oil lease on choice Florida oil land, also mineral rights. Write owner, R. R. Starnes, P.O. Box 7, Orlando, Fla.

WANTED: Producing Oil and Gas leases in Elk and Cowley County, Kansas. Please give full description in first letter. P.O. Box 1148, Ponca City, Oklahoma.

DRILLING BLOCKS WANTED

Will give straight bonus for solid drilling blocks of 3,000 to 5,000 acres. Must have shooting picture or subsurface geology, or both. Will consider blocks in Tex., Ark., La., Miss., and Kans. Deal with owners only. Give full particulars in first letter. Box 324, Houston, Texas.

WANTED

WANTED: Contractor with outfit capable of 6000-foot hole in Florida. Describe rig, price per foot. P.O. Box 2293, Orlando, Florida.

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Gas gasoline project by independent having equipment and facilities to handle 10 million cubic feet or better. Interested in high or low pressure wet gas area. Good gasoline content, good reserves, sufficient wells aready drilled for a daily gasoline production of 6,000 gallons or more. Prefer project with market for residue dry gas. Give all information possible first letter. Box C-205, The Oil and Gas Journal, Tulsa, Okla.

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Power slush pump approximately 8 x 5 x 8, small rotary and swivel large enough for 1,000 ft. of 7-in. hole. P.O. Box 636, Monroe, La.

STEEL STORAGE TANKS: 12 Horizontal Welded 12,000 to 20,000-gal. capacity. Give lowest price f.o.b. cars and location. The W. H. Dyer Co., Fullerton Bldg., St. Louis 1, Mo.

A SULLIVAN 300 or Failing 66 Drilling Rig with or without drill pipe. Furnish inventory, condition, location and price asked for equipment. Box C-200, The Oil and Gas Journal, Tulsa, Oklahoma.

ONE 500-600 hp. and one 300-400 hp. straight water tube Boiler (prefer B & W or Heine or equal); 150 to 200 lbs.; box header or sec. header; trim; oil fired with or without oil firing equipment. Priced for resale within ceiling. J. Parker Thompson Co., 507—5th. Ave., New York City (17).

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